WERA-1017 Meeting
July 8-9 2016
Boise, ID

Minutes

WERA -1017 Plan

WERA-1017 5 year plan was approved for 10/1/16 to 9/30/21
Handout (attached) provided with the approved plan.
Reporting for this year's plan will be done under the objectives of the current plan (10/1/11 to 9/30/16).
Recommended that focus is on current year outcomes but also include highlights from the other 4 years.

Administrative Advisor

Tom Holtzer will be retiring an leaving his appointment of the administrative advisor for WERA-1017
We need to identify a replacement. Must be a department head or director of the ag experiment station. One suggestion was Bill Boggess from Oregon State University.
William Boggess
Executive Associate Dean
Office: 541-737-2331
Strand Agriculture Hall 430B
170 SW Waldo Place
Corvallis, OR 97331

Members are encouraged to think of others and send suggestions to Cheryl Wilen (cawilen@ucanr.edu)

NIMSS system has been revamped to make it a bit easier to work through. Tom will work with Cheryl to enter information as required

Paul Jepson from Oregon State University volunteered to be chair elect (2016-2017) for WERA-1017. The group unanimously supported this. Paul will be chair of WERA-1017 in 2017-2018.

Planning for 2017

Ed Bechinski (current chair) suggested that we concentrate of goals 2, 5 (see attached plan)
#2 [Increased awareness of the breadth and scope of each state's Extension IPM and related programs beyond USDA-NIFA supported activities, leading to: a) enhanced collaborations among WERA1017 participants leading to better research and outreach programs that enhance adoption of IPM b) sharing of ideas, methodologies and materials that can be used or adapted to support IPM adoption in other states with reduced duplication of efforts c) new regionally-coordinated extension programming activities, educational approaches and outreach materials through jointly-developed multistate grant proposals]:

- WIPMC was approached by Western Governors Association (WGA). WGA wants to do an invasive pest inventory.
    - This might be an opportunity to set policy with the outcome of increased funding for IPM research and extension for those pests.
- Impact of invasive species on disruption/interruption of IPM
    - Potential outcome: "Top 10 Disrupters of IPM" because management of these invasives, especially regulated ones, is usually involves broad spectrum pesticides

- Identify emerging or expected/predicted to emerge pests and diseases

#5 Professional Development

- Tours could be enhanced by including dialogue with clientele
    - Meet with grower to talk about IPM systems
    - We contribute to each other's professional development by seeing/discussing what each other state is doing through our meeting
- Use the 2018 International IPM Symposium (likely in Baltimore area) to organize a symposium highlighting WERA-1017 programs

Outcomes

Suggestion that we use the state reports to pull out outcomes but it is hard to show that the outcomes are a result of WERA-1017.

#7 [*Meaningful contributions to shaping USDA NIFA policy through annual WERA1017 representation and informed contributions to discussions at the National IPM Coordinating Committee meeting*]:

Report from Doug Walsh

- Bringing forward IPM ideas
- Regional IPM Centers tag onto it
- Formalized ECOP/ESCOP
    - First formal meeting October 18-19, 2016 at APLU building in D.C.
    - There is a Chair, Chair-elect, and Past Chair; Doug is Chair-elect. They will meet shortly in Minneapolis to organize the meeting
    - While invited members are chairs of regional IPM coordinating committees and IPM Centers, others are welcome to attend
    - NIPMCC should work with professional societies to make a case for IPM by using their advocacy consultants from each of those groups
- WERA rep will send out request for input to bring to NIPMCC meeting
- Suggest that we work strongly with WIPMC to speak with one voice
- Outcomes: for annual report "we contributed to policy development at the federal level by participating at NIPMCC etc."

<u>USDA-NIFA Funding Opportunities</u>

- Bob Nowierski from USDA-NIFA gave a presentation about current grant opportunities and requirements for applying. He allowed us to provide his PPT to WERA-1017 (attached).
- There was some discussion about indirect costs. There was some concern that reduction in IDC makes the project less relevant to University administration. Conversely, others stated that because of high overhead even in small grants that they have to manage more grants.

- CPPM Project Director Meeting
    - Coordination and collaboration to obtain and increase adoption in ag and urban settings
    - Use NIMSS to get information about other related WERA groups
    - Use IPM Centers to enhance flow of information
    - NIFA requests that outputs and impacts be shared with NIFA (see ppt from Bob for links)

- Priorities:

    - Food loss and waste
    - Pollinator decline

- If there is an EIPD priority change, contact the project director to make the modification, however there is no increase in funding to address the new priority.

Activities
The members toured a small native plant nursery and organically based seed production farm/CSA. The tour then went to a botanical garden managed by UI where a regional extension educator discussed working exploring similar regions in the west to identify and collect native plants that could be commercialized for low water use landscapes. There were some comments by WERA members that care should be taken to introduce new pests as well as be mindful of potential invasiveness of the plants when introduced in new areas. This was followed by field stops and discussion of pests and diseases and their management by field station specialists working with onions, hops, and pome fruits, and grapes. The final stop was a private commercial vineyard. The owner spoke to the group about the work he does in his other jobs regarding introducing pollinators for seed alfalfa and technology for plant monitoring.

WIPMC facilitated the meeting with WERA-1017 members on July 8, 2016 where each state representative provide an oral report of IPM activities (attached) and two funded ARAP (?) grants. After the reports, members discussed broad topics were there was interest in collaboration (see attached). There were also ideas presented where regional efficiencies could be achieved such as the climate-based online pest modelling, development of web or mobile apps, and on-line training (especially for pesticide safety).

Offline discussions occurred during breaks. At one of these discussions, Paul Jepson volunteered to lead the development of a position paper about pesticide risk with other WERA-1017 members being co-authors.

Meeting adjourned 3pm July 8, 2016.

Outcomes from this meeting

Outcomes and Impacts As listed in the WERA-069 project (10/01/2011 to 09/30/2016)	Related Objective(s)*	Details
Participants will form a functioning and responsive network, with access to shared expertise, improved grantsmanship and administration, and program development.	1, 3, 4	• WIPMC now hosts a repository for assessment/evaluations tools developed by WERA-1017 members (need url). Extension members and others can access these tools to adapt for their specific uses. • Also suggested that the Pacific Island groups work together to identify issues and send a representative to the meeting to ensure that those groups have representation in the network.
WERA-069 priorities, reflecting our stakeholder identified needs, will appear in regional and	2	• At least 3 members committed to attend the NIPMCC meeting in October 2016 in D.C. WERA members attended NIPMCC meeting

national IPM RFAs, programs and policies.		in the previous 4 years as well as and were on the executive planning committees • Discussion included: • impacts of indirect costs from federal grants on programming • potential shifts of funding to better address stakeholder needs
WERA-069 will serve as a forum from which new collaborations emerge among its members and their stakeholders.	1, 3, 4	WIPMC facilitated discussion with WERA members to identify areas of interest and potential collaborations and improve efficiencies by identifying common issues and resources within the region.
State IPM programs will better address regional pest and environmental issues, have access to other state programs and opportunities to participate in coordinated, multi-state efforts.	1, 2, 3, 4	State reports provided a spark to ignite discussion among state IPM programs for sharing of resources such as online training for pesticide safety and education, IPM decision support for agricultural commodities, and urban and community IPM.

*Objectives

1. Increase participants' skills, knowledge, and awareness of regional/national IPM issues, systems, and strategies.
2. Increase relevance of federal and regional IPM RFA's, programs, and policies to better align them with regional stakeholder needs.
3. Enhance collaboration, sharing of ideas, and hence creation of regional outputs such as multi-state grants and shared outreach materials.
4. Improve coordination of IPM programs that address on-going, emerging and other critical pest and related environmental issues.

ANNUAL STATE IPM REPORT FOR CALIFORNIA

Submitted by: James Farrar, Director

Submitted: July 7, 2016

Summary:

Former director Kassim Al-Khatib accepted the Melvin D. Androus Endowed Professorship for Weed Science at UC Davis. Two new IPM advisors, working on urban IPM in Southern California and agricultural IPM in the North San Joaquin Valley, have joined our team. We have several new staff additions: an urban IPM educator, program support assistant, content development supervisor, pesticide safety educator, and writer/editor. New resources include a Pest Note on wild pigs. New online tools include the Agricultural Pest Management Decision-Support Tool, Herbicide Symptoms Photo Repository and Seasonal Landscape IPM Checklist.

Accomplishments and Impacts (2015)

Area Addressed—Urban and Community IPM

Activity—Capturing the ABCs of Bed Bug Management: Bed bug management is especially challenging in low-income multi-unit housing (MUH) situations.

Outputs:

- IPM Advisor Andrew Sutherland and several western urban entomologists and extension specialists formed a working group with funding provided by USDA's Western Integrated Pest Management Center.
- An online survey was developed and distributed to pest management professionals (PMPs) to assess their current bed bug management practices, the most challenging aspects associated with bed bug management in MUHs, and the self-reported needs of the industry that may improve bed bug management outcomes in these environments.
- 2 publications (also in publications list)
    - Sutherland, A. M., D. Choe, V. Lewis, D. Young, A. Romero, H. Spafford and D. Gouge 2015. Survey sheds light on bed bugs in multi-unit housing. Pest Control Technology, September.
    - Campbell, K., A. Sutherland, V. Lewis and D. Choe. 2015 California multi-unit housing managers answer bed bug survey. California Apartment Manager.

Impacts:

- Sutherland's survey led to a better understanding of current bed bug management used by PMPs in MUHs. He also determined the challenges faced by PMPs. It is anticipated that having this information can lead to new research that develops solutions to some of the problems identified.
- Providing outreach information to MUH management, staff, and tenants could increase their ability to make informed choices that help with bed bug management.

Activity—Checklist Guides Pest Management Activities: At least half the pesticides used in California are applied in urban or residential areas, targeting pests that infest landscape plants and other outdoor areas. Landscape professionals and gardeners who manage outdoor pests and problems often don't know what problems to anticipate and things to look for from season to season. Associate Director for Urban and Community IPM, Karey Windbiel-Rojas, working with UC IPM Writer Steve Dreistadt, and a team of UCCE advisors, specialists, UC Master Gardeners, and other staff, helped create a regional and seasonal checklist to help landscape professionals and gardeners find pest-specific IPM information.

Outputs: The seasonal landscape IPM checklist enables professionals and gardeners to identify pest-related activities to implement throughout the year. Users are able to subscribe to receive monthly email alerts for their region and download a PDF of their checklist.

Impacts:

- Prevention is an important component of an IPM program and the checklist delivers prevention practices by providing an easy means to know what to do and when.
- Employing timely IPM practices such as cultural control, mechanical control, and biological control can help reduce the application of pesticides in landscapes, thereby keeping pesticides out of the environment.

Area Addressed—Agricultural Production IPM

Activity—Chlorpyrifos Project Partnership Yields Trainings and New Decision-Support Tool: Last year, Area IPM Advisor Pete Goodell and Project Coordinator Lori Berger convened industry leaders to create guidelines regarding chlorpyrifos use in their cropping systems. This year, Goodell and Berger developed extension tools and trainings.

Outputs:

- Seven trainings covered IPM in alfalfa, almond, citrus and cotton. Sessions led by local farm advisors included UC IPM, DPR, NRCS, and county agricultural commissioner offices and presented relevant IPM information and regulatory updates. "We're very proud with how the trainings equip the user community with up-to-date information in light of current regulatory changes at local, state, and national levels," says Berger.
- A new web-based decision-support tool was also featured (http://ipm.ucanr.edu/decisionsupport/)

Impacts:

- Last year's crop team discussions focused on understanding the critical needs of chlorpyrifos use by growers and pest control advisors. Increased understanding by CE advisors of these grower and pest control adviser situations formulated better IPM trainings for this important clientele.
- Trainings increase awareness of growers and pest control advisers to alternative practices and the importance of using chlorpyrifos only when necessary.

Activity—Small Farms Demonstrate Innovative IPM Solutions: Small farms face a different set of challenges than larger farm operations. Large-scale research and extension may not translate well to small farms. Small-scale farmers often have other off-farm jobs and they are not always familiar with CE. English may not be a small-scale farmer's native language. Area IPM Advisor Cheryl Wilen partnered with IPM scientists in five other states as part of the western small-farm IPM working group. Funded by the USDA NIFA, the workgroup formed in 2010 to better serve small-scale growers and understand their needs. Wilen and UCCE Small Farms Advisor Ramiro Lobo focused on pitahaya, or dragon fruit, farming in southern California. Wilen and the other researchers on the project observed

small-scale farmers creating innovative pest solutions. Wilen observed pitahaya farmers covering fruit with paint-filter bags to protect fruit from bird feeding.

Outputs: Posters and presentation at the 8th International IPM Symposium (also in publications list)

- Grasswitz, T., D. Alston, E. Bechinski, D. Drost, G. Ellen, E. Gomez, R. Lobo, M. Ostrom, D. Walsh, C. Wilen, C. Williams. 2015. IPM for urban and other small-scale farmers in the western US: Challenges and opportunities. Pp.47–48. 8th International Integrated Pest Management Symposium, Salt Lake City, UT.
- Grasswitz, T., E. Gomez, D. Alston, D. Drost, D. Walsh, M. Ostrom, E. Bechinski, C. Williams, G. Ellen, C. Wilen, R. Lobo. 2015. Outcomes of the Western Small Farm IPM Working Group: Constraints and prospects for IPM on small farms. 8th International Integrated Pest Management Symposium. P. 84. Salt Lake City, UT.

Impacts:

- Workgroup members gained knowledge of innovative pest management practices to share with other small-scale farmers.
- The west now has a network of small farm experts who better understand the needs of small-scale farmers.
- This increase in knowledge will enable CE to better serve this clientele.

Activity—Trap Modification Increases Usability for Gopher Management: Trapping is a useful and effective tool for managing damaging pocket gophers. Methods to increase trapping effectiveness are in high demand. The Gophinator trap is more efficient than the Macabee trap, because it captures larger pocket gophers more effectively. However, the Macabee trap is still popular and widely used. Large stockpiles of these traps are held by land managers and pest control operators. With so many Macabee traps available, Affiliated IPM Advisor Niamh Quinn wanted to make these traps work better. Quinn and others from UCCE, the CSU system, and USFWS added a cable restraint to the front of the Macabee trap. Quinn found that the Gophinator trap was still the most effective option, even when compared to the modified Macabee trap. However, the modified Macabee trap did increase the capture of larger pocket gophers when compared to the standard Macabee. The unmodified Macabee trap was more effective against smaller gophers. Using gloves to mask human scent did not impact capture efficiency or visitation rate.

Outputs: 1 publication (also in publications list)

- Baldwin, R. A., A. Chapman, C. P. Kofron and N. Quinn. 2015. Refinement of a trapping method increase its utility for pocket gopher management. Crop Protection 77:176–180.

Impacts:

- It is expected that trappers will use this information to better select appropriate trap types, which can lead to increased effectiveness of pocket gopher trapping programs.
- The strengthened partnership between UC, CSU and USFWS was another positive outcome from this project.

Activity—Managing Scales and *Botryosphaeria* Cankers in Walnut: Scale infestation in walnut orchards has increased in recent years. Possibilities for the increase include decreased parasitism, increased hyperparasitism (parasitism of the parasites), changes in cultural practices, and reductions in broad-spectrum insecticide use for other pests. Information is needed to develop a more detailed management approach. To further complicate matters, scale feeding is associated with an increase in *Botryosphaeria* infection, which can kill major branches in older trees. The increase in *Botryosphaeria* cankers has lowered the tolerance levels of scale in orchards. Area IPM Advisor Emily

Symmes, Area IPM Advisor Kris Tollerup and others in UCCE are working to improve understanding of the scale species present in walnut orchards. Their research thus far has involved identifying the predominant scale species, tracking the life cycles, and evaluating parasitism rates of walnut scale as a possible cause for the recent increase in scale numbers.

Outputs: 1 publication (also in publications list)

- Symmes, E. 2015. Scale Pests of Walnut: Implementing IPM in a Changing Environment. CAPCA Adviser February Vol. XVIII, no. 6. pp. 38–42.

Impacts:

- Results of this research will enable growers and pest control advisers to manage scales more effectively using the appropriate thresholds, techniques, and timings.
- Effective scale management may also reduce the incidence of *Botryosphaeria* dieback, reducing the need for fungicides.

Area Addressed—Natural Areas IPM

Activity—Knowledge Gaps Identified for Medusahead Management: Medusahead competes with desired grasses and flowering plants for nutrients, forms a dense mat that prevents establishment of desired species, and increases the risk of wildfire. Systematic research reviews identify patterns of management success across multiple research studies. Reviews of this type, however, may not yield the specific information needed by wildland managers. UCCE Specialist and Affiliated IPM Advisor Jeremy James sought to do both.

Outputs:

- James and others in CE and UC Davis conducted a systematic review of medusahead IPM.
- James then compared his review results with an assessment of stakeholder needs to identify critical knowledge gaps in medusahead management. Stakeholders listed grazing as a preferred IPM tool. James's systematic review determined on annual rangeland an almost 2-fold reduction in medusahead abundance by stocking the area with high numbers of livestock, such as sheep or cattle, at the same time when medusahead is most susceptible to defoliation.
- Four major information needs emerged based on the systematic review and stakeholder survey.

Impacts:

- James's review increased the understanding of key knowledge gaps and economic constraints that limit adoption of IPM practices by stakeholders. Knowing the gaps means research can be targeted to better understand this lack of information.
- Through the systematic review, public land managers and conservation groups have a synopsis of management results from all recent research, rather than having to distill it themselves from numerous research papers and presentations.
- It is expected that making science-based management guidance easier to understand will result in an increase in end users who use these IPM practices.

Area Addressed—Pesticide Safety

Activity—Meeting the Changing Needs of Pesticide Fieldworker Trainers: The Federal Agricultural Worker Protection Standard is changing. One of the major changes is that annual training will be required for fieldworkers; previously training was required every five years. The changing Worker Protection Standard created a need for well-trained, up-to-date trainers of fieldworkers. These trainers are Pesticide Safety Education Program Coordinator Lisa Blecker's clientele. Her Program is working diligently to address that need.

Outputs:

- Blecker's first step was to develop new train-the-trainer materials. These materials consist of PowerPoint presentations, handouts, notebooks, and instruction on laws and regulations, training requirements, and training techniques. The training materials include activities to help participants understand more about training requirements, such as label reading. Comprehension exercises include a discussion of hazard communication requirements and an exercise to reinforce knowledge of restricted entry intervals (REIs) and field posting requirements.
- The fieldworker training kit is a great addition developed by Blecker and her team. The kit consists of nine sessions that cover all the required elements of fieldworker pesticide safety training (as stated in 3CCR Section 6764). The fieldworker training kits are in Spanish, but the activities are scripted in English and in Spanish. Two short videos are in Spanish with English subtitles.

Impacts:

- With Blecker's new materials and training kit, participants of her trainings will have more knowledge of how to train fieldworkers.
- Trainers will use what they learned and the training kit in their trainings for fieldworkers.
- It is anticipated that greater fieldworker knowledge will lead to increased safe use of pesticides.

Publications

2015 Peer-Reviewed Publications

2015. *UC IPM Pest Management Guidelines: Avocado*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3436. http://ipm.ucanr.edu/PMG/selectnewpest.avocado.html

2015. *UC IPM Pest Management Guidelines: Artichoke*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3434. http://ipm.ucanr.edu/PMG/selectnewpest.artichoke.html

2015. *UC IPM Pest Management Guidelines: Caneberries*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3437. http://ipm.ucanr.edu/PMG/selectnewpest.caneberry.html

2015. *UC IPM Pest Management Guidelines: Pistachio* Nematodes. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3461. http://ipm.ucanr.edu/PMG/r605200111.html

2015. *UC IPM Pest Management Guidelines: Grape*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3448. http://ipm.ucanr.edu/PMG/selectnewpest.grapes.html

2015. *UC IPM Pest Management Guidelines: Alfalfa*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3430. http://ipm.ucanr.edu/PMG/selectnewpest.alfalfa-hay.html

2015. *UC IPM Pest Management Guidelines: Citrus*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3441. http://ipm.ucanr.edu/PMG/selectnewpest.citrus.html

2015. *UC IPM Pest Management Guidelines: Nectarine*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3451. http://ipm.ucanr.edu/PMG/selectnewpest.nectarine.html

2015. *UC IPM Pest Management Guidelines: Peach*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3454. http://ipm.ucanr.edu/PMG/selectnewpest.peach.html

2015. *UC IPM Pest Management Guidelines: Almond*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3431. http://ipm.ucanr.edu/PMG/selectnewpest.almonds.html

2015. *UC IPM Pest Management Guidelines: Cherry*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3440. http://ipm.ucanr.edu/PMG/selectnewpest.cherries.html

2015. *UC IPM Pest Management Guidelines: Rice*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3465. http://ipm.ucanr.edu/PMG/selectnewpest.rice.html

2015. *UC IPM Pest Management Guidelines: Apple*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3432. http://ipm.ucanr.edu/PMG/selectnewpest.apples.html

2015. *UC IPM Pest Management Guidelines: Cole Crops* Leafrollers. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3442. http://ipm.ucanr.edu/PMG/r108300411.html

2015. *UC IPM Pest Management Guidelines: Pecan*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 3456. http://ipm.ucanr.edu/PMG/selectnewpest.pecans.html

2015. *UC IPM Pest Notes: Perennial Pepperweed.* University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 74121. http://ipm.ucanr.edu/PMG/PESTNOTES/pn74121.html

2015. *UC IPM Pest Notes: Skunks*. University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 74118. http://ipm.ucanr.edu/PMG/PESTNOTES/pn74118.html

2015. *UC IPM Pest Notes: Wild Pigs.* University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 74170. http://ipm.ucanr.edu/PMG/PESTNOTES/pn74170.html

2015. *UC IPM Pest Notes: Whiteflies.* University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 7401. http://ipm.ucanr.edu/PMG/PESTNOTES/pn7401.html

2015. *UC IPM Pest Notes: Opossum.* University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 74123. http://ipm.ucanr.edu/PMG/PESTNOTES/pn74123.html

2015. *UC IPM Pest Notes: Hobo Spider.* University of California Statewide Integrated Pest Management Program. Oakland: UC ANR Publication 7488. http://ipm.ucanr.edu/PMG/PESTNOTES/pn7488.html

2015 Peer-Reviewed Publications

Ferguson, H. J., A. C. Gerry, J. L. Talley and B. Smythe. 2015. VetPestX: Finally! An Online, Searchable, Pesticide Label Database Just for Pests of Animals. Journal of Extension. Vol. 53, no. 3. http://www.joe.org/joe/2015june/tt7.php accessed June 28, 2016

Westerdahl, B., D. Long, C. T. Schiller and C. A. Wilen. 2015. Nimitz (MCW-2) for management of root-knot nematode in tomatoes. Acta Horticulturae 1069:260–264.

Godfrey, L. D. and V. M. Barlow. 2015. Aphids. In Compendium of Alfalfa Diseases and Pests (3rd ed.). American Phytopathological Society. pp. 80–83.

Goodell, P. B., F. G. Zalom, J. F. Strand, C. A. Wilen and K. Windbiel-Rojas. 2015. Maintaining long-term management: Over 35 years, integrated pest management has reduced pest risks and pesticide use. California Agriculture 68(4): 153–157.

Joseph, S. V. and J. Zarate. 2015. Comparing efficacy of insecticides against cabbage maggot (Diptera: Anthomyiidae) in the laboratory. Crop Protection 77:148–156.

Joseph, S. V., E. R. Hoebeke and J. V. McHugh. 2015. Rove beetles of the genus *Aleochara* Gravenhorst (Coleoptera: Staphylinidae) parasitizing the cabbage maggot, *Delia radicum* (L.) (Diptera: Anthomyiidae), in the northern Central Coast of California. Proc. Entomol. Soc. Wash. 117:525–528.

Baldwin, R. A., A. Chapman, C. P. Kofron and N. Quinn. 2015. Refinement of a trapping method increase its utility for pocket gopher management. Crop Protection 77:176–180.

2015 Extension Bulletins/Newsletter Articles/Technical Reports/Blog Posts

Stapleton, J. and S. Orfoff. 2015. Dyer's Woad – An Invasive Weed Pest Threatening the Intermountain Region of California. CAPCA Adviser February Vol. XVIII, no. 1. pp. 36–38.

Dara, S. 2015. Integrating Chemical and Non-chemical Solutions for Managing Lygus Bug in California Strawberries. CAPCA Adviser February Vol. XVIII, no. 1. pp. 40–44.

Berger, L. and P. Goodell. 2015. PCAs to Play Elevated Role in Decision-Making and Stewardship. CAPCA Adviser February Vol. XVIII, no. 2. pp. 46–49.

Joseph, S. 2015. Efficacy of Novel Insecticides Against Lettuce Aphid in Leafy Lettuce. CAPCA Adviser February Vol. XVIII, no. 3. pp. 46–47.

Al-Khatib, K. and T. A. Martin. 2015. Reducing Herbicide Drift Injury. CAPCA Adviser February Vol. XVIII, no. 4. pp. 40–42.

Dara, S. 2015. Twospotted Spider Mite and its Management in Strawberries. CAPCA Adviser February Vol. XVIII, no. 4. pp. 56–58.

Joseph, S. 2015. Effect of Insecticide Application Timing on Feeding Injury of Bagrada Bug in Broccoli. CAPCA Adviser February Vol. XVIII, no. 4. pp. 60–61.

Tollerup, K. Leaffotted Bug: What We Know and What We Need to Know. CAPCA Adviser February Vol. XVIII, no. 5. pp. 50–54.

Symmes, E. 2015. Scale Pests of Walnut: Implementing IPM in a Changing Environment. CAPCA Adviser February Vol. XVIII, no. 6. pp. 38–42.

Quinn, N. 2015. Pocket Gopher and Ground Squirrel Control: Management Options for Citrus and Avocado Groves. CAPCA Adviser February Vol. XVIII, no. 6. pp. 48–52.

Varela, L. 2015. Progress Made on Control of the European Grapevine Moth: Present Status and Next Steps. CAPCA Adviser February Vol. XVIII, no. 6. pp. 54–56.

Farrar, J. J., M. E. Baur, K. Murray and S. Elliott. 2015. Integrated pest Management Improvements in Hops from 2008 to 2015. 4 pages. Western IPM Center. http://westernipm.org/index.cfm/about-the-center/publications/special-reports/ipm-improvements-in-hops-pdf/

Farrar, J. J., M. E. Baur and S. Elliott. 2015. Impacts of the Regional Integrated Pest Management Competitive Grants Program in the Western United States. 20 pages. Western IPM Center. http://westernipm.org/index.cfm/about-the-center/publications/special-reports/western-ripm-retrospective-full-pdf/

Farrar, J. J., M. E. Baur and S. Elliott. 2015. Adoption and Impacts of Integrated Pest Management in Agriculture in the Western United States. 66 pages. Western IPM Center. http://westernipm.org/index.cfm/about-the-center/publications/special-reports/adoption-and-impact-of-ipm-in-western-agriculture/

2015 Extension Bulletins/Newsletter Articles/Technical Reports/Blog Posts

2015. Retail Nursery and Garden IPM Newsletter. Volume 5: 1. University of California Statewide IPM Program.

2015. Retail Nursery and Garden IPM Newsletter. Volume 5: 2. University of California Statewide IPM Program.

2015. Retail Nursery and Garden IPM Newsletter. Volume 5: 3. University of California Statewide IPM Program.

2015. Green Bulletin Newsletter. Volume 5: 1. University of California Statewide IPM Program.

2015. Green Bulletin Newsletter. Volume 5: 2. University of California Statewide IPM Program.

2015. Green Bulletin Newsletter. Volume 5: 3. University of California Statewide IPM Program.

2015. Pest Alert: Brown Marmorated Stink Bug. University of California Statewide IPM Program.

2015. Quick Tips. University of California Statewide IPM Program.

- Bed Bugs
- Ground Squirrel
- Powdery Mildew
- Rats
- Scales
- Snails and Slugs
- Whiteflies
- Beneficial Predators
- Common Garden Spiders
- Lady Beetles
- Landscape Design & Water Quality
- Landscape Plants: Fertilizing & Watering

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Goodell, P. B. and L. A. Berger. 2015. Identifying and managing critical uses of chlorpyrifos against key pests of cotton. 4pp. University of California Statewide IPM Program

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- Blog: UC Weed Science. http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=19955
- Blog: Pests in the Urban Landscape. http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=19931
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- Blog: Strawberries and Vegetables (780 hits)
- Blog: The Almond Doctor
- Blog: Topics in Subtropics (457 hits)
- Blog: UC Weed Science (1078 hits)
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- Blog: Fruit & Nut Research & Information (683 hits)
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- Blog: IPM in Field Crops (289 hits)
- Blog: Strawberries and Vegetables (395 hits)
- Blog: Topics in Subtropics (269 hits)
- Blog: UC Weed Science (421 hits)
- Blog: Salinas Valley Agriculture (215 hits)
- Blog: Southern IPM Activities (357 hits)
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- Blog: Citrus Bugs (450 hits)
- Blog: IPM in Field Crops (193 hits)
- Blog: Strawberries and Vegetables (475 hits)
- Blog: Topics in Subtropics (298 hits)
- Blog: UC Weed Science (818 hits)
- Blog: Salinas Valley Agriculture (314 hits)
- Blog: Pests in the Urban Landscape (227 hits)

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Reynolds, C. 2015. UC IPM online courses offer continuing education units. http://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=19473

- Blog: Pest News (205 hits)
- Blog: Alfalfa and Forage News (167 hits)
- Blog: Citrus Bugs (182 hits)
- Blog: IPM in Field Crops (114 hits)
- Blog: Topics in Subtropics (204 hits)
- Blog: UC Rice Blog (194 hits)
- Blog: UC Weed Science (300 hits)
- Blog: Kearney News Updates (457 hits)
- Blog: Southern IPM Activities (264 hits + 189 hits with reminder post)
- Blog: Pests in the Urban Landscape (264 hits)

2015. Blog: Pests in the Urban Landscape. http://ucanr.edu/blogs/UCIPMurbanpests/

2015. UC IPM Highlights Annual Report. University of California Statewide IPM Program.

2015. Guide to Vineyard Trunk Diseases in California brochure. University of California Statewide IPM Program. http://ipm.ucanr.edu/PDF/PMG/grape_trunk_disease_view.pdf

2015 Extension Online Trainings/Videos/Website Tools & Pages

Herbicide Symptoms Photo Repository. http://herbicidesymptoms.ipm.ucanr.edu/

Pest Management Decision-Support Tool for alfalfa, almond, citrus and cotton. http://ipm.ucanr.edu/decisionsupport/

Seasonal Landscape IPM Checklist. http://ipm.ucanr.edu/landscapechecklist/

UC IPM YouTube channel or http://ipm.ucanr.edu/IPMPROJECT/videolibrary.html

- Identification of parasitized alfalfa caterpillars
- Sampling with a sweep net in alfalfa

- No traiga chinches a casa al volver de viaje
- Cómo usar un detector de chinches de cama
- Light Brown Apple Moth Scouting and Field Identification

Abbreviations and Acronyms:

CE	Cooperative Extension
CSU	California State University
DPR	California Department of Pesticide Regulation
IPM	integrated pest management
MUH	multi-unit housing
NIFA	National Institute of Food and Agriculture
NRCS	Natural Resources Conservation Service
PMP	pest management professional
REI	re-entry interval
UC	University of California
UCCE	University of California Cooperative Extension
UC IPM	University of California Statewide Integrated Pest Management Program
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service

WERA 1017 Report for Washington State 2015-2016

Doug Walsh, Sally O'Neal, and Carrie Foss • Washington State University

IPM Implementation in Agronomic Crops

- Integrated weed management in small grains (wheat, barley)
  - ACTIVITY: Outreach to growers
  - OUTPUTS:
    - 10 grower group presentations
      - herbicide resistance education
      - invasive weed biology
      - weed management in an IPM context
    - updated web content
  - SHORT-TERM OUTCOMES:
    - Documented ~1,000 growers received IPM information
    - Increased knowledge of weed management in an IPM context
  - IMPACTS: More effective and sustainable weed control in small grains
- Integrated pest management and pollinator protection in alfalfa grown for seed
  - ACTIVITY:
    - Outreach to growers
    - Managed Pollinator Protection Plan ("MP3") initiated
  - OUTPUTS:
    - 4 presentations to Washington alfalfa seed growers
    - 1 presentation to Western Alfalfa Seed Growers at regional conference
    - Reports presented to commodity groups
  - SHORT-TERM OUTCOMES:
    - Increased knowledge of pollinator protection methods
    - Increased understanding of Lygus (primary pest) biology and control
    - Improved retention of pollinators
  - IMPACTS:
    - Enhanced managed pollinator populations
    - Increased yield
    - Reduced pesticide inputs
    - More economical production of alfalfa seed for national and international markets

IPM in Communities

- Hortsense and Pestsense websites
  - ACTIVITY: Updated both websites
  - OUTPUTS:
    - 100 new images
    - 4 new fact sheets
  - SHORT-TERM OUTCOMES:
    - Additional information available on common landscape, garden, and indoor pest problems
  - IMPACTS:
    - Public is better able to handle indoor and outdoor pest problems safely
    - Fewer nuisance pests creating health problems
    - More judicious/appropriate use of home and garden pesticides
- IPM in Schools
  - ACTIVITY: IPM education in schools
  - OUTPUTS: IPM Star curriculum taught to school pest control practitioners
  - SHORT-TERM OUTCOMES:

        - 4 WA school districts received IPM Star Certifications
            - Lake Washington
            - Mukilteo
            - Federal Way
            - Kelso
        - Increased knowledge of IPM methodologies among school pest control practitioners
    - IMPACTS:
        - Safer, more rational use of pesticides and non-pesticidal control methods in certified schools
        - Fewer negative health impacts from pests or pesticides in certified schools
- Public facility IPM
    - ACTIVITY: Salmon-Safe education and certification
    - OUTPUTS: IPM training for facility pest managers conducted
    - SHORT-TERM OUTCOMES:
        - Two facilities received Salmon-Safe certification
            - Seattle Children's Hospital
            - Port of Seattle Seatac
        - One facility underwent pre-assessment
            - PacTrust/Hopworks Vancouver

IPM Implementation in Specialty Crops

- *Field Guide for Integrated Pest Management in Hops*
    - ACTIVITY: Produced 3rd edition (first comprehensive national edition)
    - OUTPUTS:
        - 3,500 copies printed and distributed
        - Worked with the Hop Growers of America to digitize the Field Guide and make electronic edition available
    - SHORT-TERM OUTCOMES:
        - Increased knowledge of pest and beneficial organism identification
        - Increased knowledge of IPM, including scouting, thresholds, phytosanitation, and resistance management
        - Cooperation and technology transfer among many hop-growing states
    - IMPACTS: Increased adoption of IPM tactics among U.S. hop growers

- Spanish-language viticulture publications
    - ACTIVITY: Several grape publications (listed under Publications in this report) translated to Spanish
    - OUTPUTS: Printed and electronic grape pest management and production publications
    - SHORT-TERM OUTCOMES:
        - Spanish-speaking vineyard owners, managers, and workers now have access to best management practice information
        - Increased knowledge of vineyard IPM among native Spanish speakers
    - IMPACTS: Greater area-wide implementation of IPM in Washington vineyards

- Aquatic crop (cranberry, shellfish) IPM outreach
    - ACTIVITY: Multi-modal IPM education
    - OUTPUTS:
        - 8 workshops organized, publicized, and presented to growers
        - Fact sheets produced

        - Newsletters written and posted electronically
    - SHORT-TERM OUTCOMES: Increased and updated knowledge among cranberry and shellfish producers on control of insect, weed, disease, and mollusk pests in sensitive estuarial environments
    - IMPACTS: Restoration and improvement of coastal and estuarial habitats
- Brown marmorated stink bug (BMSB) tracking and control
    - ACTIVITY:
        - Methodical tracking of new invasive species
        - Outreach regarding presence and control of BMSB
    - OUTPUTS:
        - Website content
        - Presentations to workshops and grower groups statewide
        - Tours of parks, vineyards, and public areas for BMSD ID and education
    - SHORT-TERM OUTCOMES: Increased grower knowledge of BMSB ID and control
    - IMPACTS: WA tree fruit and other specialty crop producers prepared to be proactive if BMSB becomes an economic pest in the region

Publications

Peer-Reviewed

Bahder, B., L.D. Bahder, M. Hauser, E. Beers & D.B. Walsh. 2016. Relative abundance and phenology of Drosophila Fallen, 1815 (Diptera: Drosophilidae) species in south-central Washington State. Pan-Pacific Entomologist, Vol. 92-2

Bahder B, LD Barrantes Barrantes, K Hamby, M Pascual, F Zalom, DB Walsh. 2015. Population Genetics of *Drosophila suzukii* (Diptera: Drosophilidae) in Washington State and California. *Environmental Entomology.* DOI: 10.1093/ee/nvv117.

Calderon FJ, D Nielsen, V Acosta-Martinez, M Vigil, D Lyon. 2016. Cover crop and irrigation effects on soil microbial communities and enzymes in semiarid agroecosystems of the Central Great Plains of North America. *Pedosphere:* 26:192-205.

Hurisso TT, U Norton, JB Norton, J Odhiambo, SJ Del Grosso, GW Hergert, DJ Lyon. 2016. Dryland soil greenhouse gases and yield-scaled emissions in no-till and organic winter wheat-fallow systems. *Soil Science Society of America Journal:* 80:178-192.

Lyon DJ, DR Huggins, JF Spring. 2016. Windrow burning eliminates Italian ryegrass *(Lolium perenne* ssp. *multiflorum)* seed viability. *Weed Technology:* 30:279-283.

Morales M. A., B. M. Mendoza, L. C. Lavine, M. D. Lavine, D. B. Walsh, F. Zhu 2016. Selection of Reference Genes for Expression Studies of Xenobiotic Adaptation in *Tetranychus urticae*. International Journal of Biological Sciences. 12(9): 1129-1139. doi: 10.7150/ijbs.16319

Patten KD. 2015. Imazamox control of invasive Japanese eelgrass: efficacy and nontarget impacts. *Journal of Aquatic Plant Management:* 53:85-190.

Piraneo TB, F Zhu, J Bull, MD Morales, LC Lavine, DB Walsh. 2015 Mechanisms of *Tetranychus urticae* chemical adaptation in Pacific Northwest hops field. *Scientific Reports:* 5:1-12.

Walsh, D.B., S.D. O'Neal, A.E. George, D.P. Groenendale, R.E. Henderson, G.M. Groenendale, & M.J. Hengel. 2016 Evaluation of Pesticide Residues from Conventional, Organic, and Non-treated Hops on Conventionally Hopped, Late-Hopped and Wet-Hopped Beers. Journal of the Association of Brewing Chemists.

http://dx.doi.org/10.1094/ASBCJ-2016-1115-02

Zhu, F., L. Lavine, S. O'Neal, C. Foss, & D. Walsh. 2016 Integrated Management of Insecticide Resistance in Urban Ecosystems. Insects 7, 2.

Extension

Gohil H, M Keller, M Moyer. 2016. On-farm vineyard trials: A grower's guide. Washington State University Extension Manual EM098E. 23 pp.

Hoheisel G, M Moyer. 2016. Pest Management Guide for Grapes in Washington. Washington State University Extension Bulletin EB0762. 57 pp.

Komm BL, MM Moyer. 2015. Vineyard Yield Estimation. WSU Extension Publication EM086E. Washington State Unversity. *Also en Expañol.*

Lyon DJ. 2016. Section D: Winter Wheat, Nonirrigated, East of the Cascades. IN: Pacific Northwest Weed Management Handbook. Oregon State University Publishing. http://pnwhandbooks.org/weeds.

Lyon DJ. 2016. Section G: Peas (Dry), Peas (Winter), Lentils, and Garbanzo Beans (Chickpeas) *Cicer arietinum.* IN: Pacific Northwest Weed Management Handbook. Oregon State University Publishing. http://pnwhandbooks.org/weeds.

Lyon DJ, IC Burke. 2016. Integrated Management of Prickly Lettuce in Wheat Production Systems. Washington State University Publishing PNW688.Morishita D, DJ Lyon. 2016. Section D: Spring Wheat. IN: Pacific Northwest Weed Management Handbook. Oregon State University Publishing. http://pnwhandbooks.org/weeds.

Moyer MM. 2015. Water Supply Resources and Reports. Viticulture and Enology Extension News. Washington State University, Fall 2015, p. 3.

O'Neal SD, DB Walsh, DH Gent, eds. 2015. Field Guide for Integrated Pest Management in Hops. 3rd Edition. Pullman, WA: US Hop Industry Plant Protection Committee. http://www.usahops.org.

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Patten KD, J Madsen, VH Morgan. 2016. Aquatic Weed Control. IN: Pacific Northwest Weed Management Handbook. Http://pnwhandbooks.org/weeds.

Walsh D. 2016. Pests of Alfalfa Grown for Seed. IN: Pacific Northwest Insect Management Handbook. A Pacific Northwest Extension Publication. Http://insect.pnwhandbooks.org.

Waters T. 2016. Sunflower Pests. IN: Pacific Northwest Insect Management Handbook. A Pacific Northwest Extension Publication. Http://insect.pnwhandbooks.org.

Extension Online Trainings/Videos/Website

Beers E et al. 2016 Brown Marmorated Stink Bug. WSU Tree Fruit Research & Extension Center. http://www.tfrec.wsu.edu/pages/bmsb.

Lawrence T, CR Foss, D Kilgore. 2015. Pollination and Pollinator Protection (video). Washington State University. https://vimeo.com/146957716.

Conference Papers (selected)

Boyle N, R Martin, S Keooju, S Greene, D Walsh. 2015. Evaluating gene and pollen flow mediated by the alfalfa leafcutting be *(Megachile rotundata)* in alfalfa seed production. Entomological Society of America, Minneapolis, MN.

Caruso F, KD Patten. 2015. Fungal Populations in PNW Cranberries as it Relates to Fruit Rot. Northwest Center for Small Fruit Research Conference.

Grula C, D Walsh. 2015. A comparative study of pollinator diversity among perennial irrigated crops and adjacent habitats in eastern Washington. Entomological Society of America, Minneapolis, MN.

Patten KD. 2015. Biotic and abiotic comparisons of tideflats in Wallapa Bay, WA with and without *Zostera japonica.* Coastal and Estuarine Research Federation Conference.

Vinchesi A, D Walsh. 2015. Manipulating soil temperatures to influence brood emergence in the alkali bee. Entomological Society of America, Minneapolis, MN.

Walsh D, J Barbour. 2015. Hop IPM in the US: Protection the 26,000 acres that flavor 10 billion pints per year. Entomological Society of America, Minneapolis, MN.

COLORADO State report

I. Urban and Housing

A. Activities

1. Systematic evaluation of traps and repellents for vespid wasps**.** Evaluations were made of all available lures, trap designs and purported repellents for their effectiveness in managing pest vespids, particularly western yellowjacket (*Polistes dominula*) and the western yellowjacket (*Vespula pensylvanica*).
2. Survey of fruiting ornamental plants for use by spottedwinged drosophila. A multiyear study was conducted to evaluate the relative use of commonly grown fruiting ornamental plants for their use by spottedwinged drosophila. In addition trapping of this insect has determined the seasonal activity of the adults.
3. Survey of pollen collected by honeybees along the Front Range has been used to identify ornamental plants on which insecticide use would be of greatest concern.
4. 20 presentations on landscape IPM, stinging insects, household invaders, fungal diseases of trees
5. 3 workshops for hardware store employees on household insects
6. Compared three hive designs for Front Range commercial and residential beekeepers.
7. Five Vegetable Troubleshooting workshops conducted
8. A 2-day, bilingual Vegetable University was presented to 14 promotoras who work with 400 backyard gardeners who grow food in metro Denver low income areas.

B. Outputs

1. See publications.

C. Short-term Outcomes

1. Vegetable Troubleshooting workshop evaluations averaged 4.5 out of a possible 5.

D. Impacts

E. Publications

1. Peer reviewed
   a. Sitz, R.A., Luna, E.K., Ibarra Caballero, J., Tisserat, N.A., Cranshaw, W.S., **Stewart, J.E.** 2016. Virulence of genetically distinct *Geosmithia morbida* isolates to black walnut and their response to co-inoculation with *Fusarium solani*. Plant Disease. Accepted.
2. Extension
   a. A poster on *Common Indoor Flies*
   b. Survey of Over-the-Counter Insecticides for Home, Yard and Garden Use, https://bspm.agsci.colostate.edu/files/2013/01/Insecticides-Trade-Names-2015-Survey-Final.pdf

c. Biological Control Organisms for Insects and Mites, https://bspm.agsci.colostate.edu/files/2013/01/Biological-Control-Suppliers.pdf
d. Wood Borers of Ash, http://webdoc.agsci.colostate.edu/bspm/Wood%20Boring%20Insects%20of%20Ash%20Trees%20-%20formatted%20April%203.pdf
e. Scorpions of Colorado, http://webdoc.agsci.colostate.edu/bspm/Arachnida%20%28Arachnids%29/Scorpions%20of%20Colorado.pdf
f. Common Pests of Schools and Structures in Colorado was updated and published online, in cooperation with Utah State University Extension
g. Three editions of the Healthy Colorado Schools newsletter were published and distributed to 400 subscribers.

F. IPM-related grants

1. Cranshaw, W. S. (PI), Grant, "Disease Description of Drippy Blight: A Unique Association Between a Scale Insect and a Plant Pathogenic Bacteria", Tree Research and Education Endowment Fund, Domestic Non-Profit (other than Domestic Foundations), $10,000.00, Active. (sub: October 1, 2015, start: January 1, 2016, end: December 31, 2016).
2. Cranshaw, W. S. (PI), Grant, "Assessing Effects on Non-target Organisms from Pesticides Used in Emerald Ash Borer Management", EPA-Environmental Protection Agency, Federal, $19,613.00, Active. (sub: June 2, 2015, start: September 1, 2015, end: August 31, 2016).
3. Cranshaw, W. S. (PI), Contract, "Identification of Pollen Collected by Honey Bees in Early Season within Urbanized Areas of Colorado", Colorado Department of Agriculture, State of Colorado, $17,810.00, Active. (sub: April 15, 2014, start: April 1, 2014, end: December 31, 2015).

II. Agriculture, Rangeland, Forestry

A. Activities

1. Initial survey of insects associated with industrial hemp
2. Thirteen invasive and noxious weed workshops
3. Two Congressional testimonies on invasive species management bills
4. Three Congressional hearing testimonies
5. Evaluated bio-nematicide, Melocon, in commercial onion production
6. Continued evaluation of commercial mycorrhyzal preparations on plant health in commercial onion production
7. Evaluated onion varieties for reactions to thrips, IYSV, and pink root fungus
8. Stripe rust monitoring and advisories throughout eastern Colorado
9. West Slope IPM workshop with 185 participants
10. West Slope surveys for spotted wing drosophila, grape leaf skeletonizer, grape bud mite, hedgehog grain aphids, African fig fly
11. Pheromone traps were used to monitor field corn and sunflower insects pests
12. The Plant Diagnostic Clinic processed more than 2000 disease and insect

samples, responding with timely diagnoses, identifications and IPM recommendations.

B. Outputs
   1. See publications
C. Short-term Outcomes
   1. Stripe rust is thought to have reduced statewide wheat yields by 25% in the 2015 crop year. This loss appears to have been greatly reduced in 2016, based on grower comments.
D. Impacts
E. Publications
   1. Books
      a. Germino, M.J., J.C. Chambers, and C.S. Brown, editors. 2016. Exotic Brome-Grasses in Arid and Semiarid Ecosystems of the Western US: Causes, Consequences, and Management Implications. Springer International Publishing, Switzerland. 10.1007/978-3-319-24930-8.
   2. Peer reviewed

1. Tredennick, A.T., P.B. Adler, J.B. Grace, W.S. Harpole, E.T. Borer, E.W. Seabloom, et al. 2016. Comment on "Worldwide evidence of a unimodal relationship between productivity and plant species richness." Science 351:457.
2. Seabloom, E.W., E.T. Borer, Y. Buckley, E.E. Cleland, K. Davies, J. Firn, W.S. Harpole, Y. Hautier, E. Lind, A.S. MacDougall, J.L. Orrock, S.M. Prober, P.B. Adler, T.M. Anderson, J.D. Bakker, L.A. Biederman, D.M. Blumanthal, C.S. Brown, L.A. Brudvig, M. Cadotte, C. Chu, K.L. Cottingham, M.J. Crawley, E.I. Damschen, C.M. D'Antonio, N.M. DeCrappeo, G. Du, P.A. Fay, P. Frater, D.S. Gruner, N. Hagenah, A. Hector, H. Hillebrand, K.S. Hofmockel, H.C. Humphries, V.L. Jin, A. Kay, K.P. Kirkman, J.A. Klein, J.M.H. Knops, K.J. La Pierre, L. Ladwig, J.G. Lambrinos, Q. Li, W. Li, R. Marushia, R.L. McCulley, B. Melbourne, C.E. Mitchell, J.L. Moore, J. Morgan, B. Mortensen, L.R. O'Halloran, D.A. Pyke, A.C. Risch, M. Sankaran, M. Schuetz, A. Simonsen, M. Smith, C.J. Stevens, L. Sullivan, E. Wolkovich, P.D. Wragg, J. Wright, L. Yang. 2015. Plant species' origin predicts dominance and response to nutrient enrichment and herbivores in global grasslands. Nature Communications 6: 771, DOI: 10.1038/ncomms8710.
3. West, A.M., S. Kumar, T. Wakie, C.S. Brown, T.J. Stohlgren, M. Laituri, J. Bromberg. 2015. Using high-resolution future climate scenarios to forecast Bromus tectorum invasion in Rocky Mountain National Park. PLOS ONE Article Number e0117893, DOI: 10.137/journal.pone.0117893.
4. Sebastian, D. J., Sebastian, J. R., Nissen, S. J., Beck, K. G. (2015). A potential new herbicide for invasive annual grass control on rangeland. Rangeland Ecology and Management, 4. dx.doi.org/10.1016/j.rama.2015.11.001 (Published: October (4th Quarter/Autumn) 2015)
5. Kessler, K. C., Nissen, S. J., Meiman, P., Beck, K. G. (2015). Litter Reduction by Prescribed Burning Can Extend Downy Brome Control. Rangeland Ecology &

Management, 68(4), 367-374.
6. Aggarwal, T., Westbrook, A., Broders, K. D., Woeste, K., MacManus, M. (2016). De novo genome assembly of Geosmithia morbida, the causal agent of Thousand Cankers Disease. BMC Genomics.
7. Killeen, D. P., Larsen, L., Dayan, F. E., Gordon, K. C., Perry, N. B., van Klink, J. W. (2016). Nortriketones: Antimicrobial Trimethylated Acylphloroglucinols from Ma nuka (Leptospermum scoparium). *Journal of natural products*.
8. Carbonari, C. A., Latorre, D. O., Gomes, G. L., Velini, E. D., Owens, D. K., Pan, Z., Dayan, F. E. (2016). Resistance to glufosinate is proportional to phosphinothricin acetyltransferase expression and activity in LibertyLink® and WideStrike® cotton. *Planta*, 1-9.
9. Dayan, F. E., Owens, D. K., Corniani, N., Silva, F. M. L., Watson, S. B., Howell, J., Shaner, D. L. (2015). Biochemical markers and enzyme assays for herbicide mode of action and resistance studies. *Weed Science*, *63*(sp1), 23-63.
10. Duke, S. O., Scheffler, B. E., Boyette, C. D., Dayan, F. E. (2015). Biotechnology in weed control. *Kirk-Othmer Encyclopedia of Chemical Technology*.
11. Alarcón-Reverte, R., García, A., Watson, S. B., Abdallah, I., Sabaté, S., Hernández, M. J., Dayan, F. E., Fischer, A. J. (2015). Concerted action of target-site mutations and high EPSPS activity in glyphosate-resistant junglerice (Echinochloa colona) from California. *Pest management science*, *71*(7), 996-1007.
12. Duke, S., Dayan, F. E. (2015). Discovery of new herbicide modes of action with natural phytotoxins. *American Chemical Society Symposium Series*, *1204*, 79-92.
13. Salas, R. A., Scott, R. C., Dayan, F. E., Burgos, N. R. (2015). EPSPS gene amplification in glyphosate-resistant italian ryegrass (Lolium perenne ssp. multiflorum) populations from arkansas (United States). *Journal of agricultural and food chemistry*, *63*(25), 5885-5893.
14. Silva, F., Duke, S., Dayan, F., Velini, E. (2015). Low doses of glyphosate change the responses of soyabean to subsequent glyphosate treatments. *Weed Research*.
15. Maroli, A. S., Nandula, V. K., Dayan, F. E., Duke, S. O., Gerard, P., Tharayil, N. (2015). Metabolic profiling and enzyme analyses indicate a potential role of antioxidant systems in complementing glyphosate resistance in an Amaranthus palmeri biotype. *Journal of agricultural and food chemistry*, *63*(41), 9199-9209.
16. Duke, S., Dayan, F., D'Mello, J. (2015). Natural toxins that affect plant amino acid metabolism. *Amino acids in higher plants*, 448-460.
17. Trivella, A., Stawinoga, M., Dayan, F. E., Cantrell, C. L., Mazellier, P., Richard, C. (2015). Photolysis of natural b-triketonic herbicides in water.
18. Trivella, A., Stawinoga, M., Dayan, F. E., Cantrell, C. L., Mazellier, P., Richard, C. (2015). Photolysis of natural â-triketonic herbicides in water. *Water research*, *78*, 28-36.
19. Ribeiro, D. N., Nandula, V. K., Dayan, F. E., Rimando, A. M., Duke, S. O., Reddy, K. N., Shaw, D. R. (2015). Possible glyphosate tolerance mechanism in pitted morningglory (Ipomoea lacunosa L.). *Journal of agricultural and food chemistry*, *63*(6), 1689-1697.
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Sarmentine, a natural herbicide from Piper species with multiple herbicide mechanisms of action. *Frontiers in plant science*, *6*.

21. Christoffoleti, P. J., Figueiredo, M., Pereira Peres, L. E., Nissen, S. J., Gaines, T. (2015). Auxinic herbicides, mechanisms of action, and weed resistance: A look into recent plant science advances. *Scientia Agricola*, *72*(4), 356-362.
22. Brunharo, C. A., Patterson, E., Carrijo, D. R., de Melo, M. S., Nicolai, M., Gaines, T., Nissen, S. J., Christoffoleti, P. J. (2015). Confirmation and mechanism of glyphosate resistance in tall windmill grass (Chloris elata) from Brazil. *Pest Management Science*.
23. Wiersma, A.T., Gaines, T., Preston, C., Hamilton, J.P., Giacomini, D., Buell, C. R., Leach, J. E., Westra, P. (2015). Gene amplification of 5-enol-pyruvylshikimate-3-phosphate synthase in glyphosate-resistant Kochia scoparia. *Planta*, *241*, 463-474.
24. Powles, S. and T. Gaines. 2016. Exploring the potential for a regulatory change to encourage diversity in herbicide use. Weed Science. 64: 649-654.
25. Ostlie, M., Haley, S. D., Anderson, V. A., Shaner, D., Manmathan, H. K., Beil, C. T., Westra, P. (2015). Development and characterization of mutant winter wheat (Triticum aestivum L.) accessions resistant to the herbicide quizalofop. *Theoretical and Applied Genetics*, *128*(2), 343-351.
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27. Nandula, V. K., Wright, A. A., Van Horn, C. R., Molin, W. T., Westra, P., Reddy, K. N. (2015). Glyphosate Resistance in Giant Ragweed (Ambrosia trifida L.) from Mississippi Is Partly Due to Reduced Translocation. *American Journal of Plant Sciences*, *6*(13), 2104-2113.
28. Kumar, V., Jha, P., Giacomini, D., Westra, E. P., Westra, P. (2015). Molecular Basis of Evolved Resistance to Glyphosate and Acetolactate Synthase-Inhibitor Herbicides in Kochia (Kochia scoparia) Accessions from Montana. *Weed Science*, *63*(4), 758-769.
29. Fazel-Najafabadi, M., J. Peng, F. B. Peairs, H. Simkova, A. Kilian, and N.L.V. Lapitan. 2015. Genetic mapping of resistance to *Diuraphis noxia* (Kurdjumov) biotype 2 in wheat (*Triticum aestivum* L.) accession CI2401. Euphytica 203: 607-614.
30. Puterka, G. J., K. L. Giles, M. J. Brown, S. J. Nicholson, R. W. Hammon, F. B. Peairs, T. L. Randolph, G. J. Michaels, E. D. Bynum, T. L. Springer, J. S. Armstrong, and D. W. Mornhinweg. 2015. Change in biotypic diversity of Russian wheat aphid (Hemiptera: Aphididae) populations in the United States. Journal of Economic Entomology 108: 798-804.
31. Merrill, S.C., T.O. Holtzer, F.B. Peairs, and P.J. Lester. 2015. Validating spatiotemporal predictions of an important pest of small grains. Pest Management Science 71: 131-138.

3. Extension

a. 2015 Golden Plains Agricultural Handbook, Vol. XII. CSU Extension, Golden Plains Area.
b. Press releases on grasshoppers in range, alfalfa weevil, Russian wheat aphid, stripe rust, European corn borer, western bean cutworm and sunflower head pests.
c. F. B. Peairs. 2015. Field key — Insect, mite pests and diseases. Pp. 147-149 in H. Schwartz and M. Brick, eds. Dry bean production and integrated pest management. 3nd Ed. Colorado State University, University of Nebraska, University of Wyoming Regional Publication. Fort Collins, CO.
d. Bradshaw, J. and F. B. Peairs. 2015. Insect management. Pp. 95-110 in H. Schwartz and M. Brick, eds. Dry bean production and integrated pest management. 3nd Ed. Colorado State University, University of Nebraska, University of Wyoming Regional Publication. Fort Collins, CO.

IPM related grants

USDA - Specialty Crop Block Grant Program Colorado, (2017-2019), coPIs Jahn, Stewart "Managing potato soil health through crop rotation length and diversity for increased economic gain in Colorado.", $90,799

Specialty Crop Block Grant Program Colorado, Reallocated Funds (2016), coPIs Stewart, Minas "Developing Chemical Strategies for Managing Cytospora Canker in Peach Orchards in Colorado", $18,201

McIntire Stennis (2016-2017), PIs C. Hoffman, M. Falkowski, S. Ex, JE Stewart, "Establishment of a large scale permanent forest dynamics plot to characterize forest health and resiliency in Colorado" $25,00

USDA FHP. Evaluation Monitoring (2016-2017), PI Stewart, coPI Burns, K. "Monitoring limber pine health in the Rocky Mountains" $90,464

Western Colorado Research Center, Extension funding "Cytospora management for Peach Production", $35,000

Broders, K. D. (PI), Contract, "Development of Integrated Management of Silver Scurf - Area II", Colorado Potato Administrative Committee, Domestic Non-Profit (other than Domestic Foundations), $10,000.00

Broders, K. D. (PI), Contract, "Investigations into the Ecology and Epidemiology of Barley Pathogens in the Central Plains", American Malting Barley Association, Inc., $2,000.00,

Broders, K. D. (PI), Contract, "Survey to Determine Diversity, Incidence and Severity of Corn

Pathogens in Colorado", Colorado Corn Administrative Committee, $31,500.00

Broders, K. D. (PI), Grant, "A Predictive Model to Increase Adoption of IPM of a Mite-Virus Disease Complex in Wheat", University of Nebraska, $117,792.00

Broders, K. D. (PI), Contract, "Comparative Genomics of Mint Pathogenic Verticillium Dahliae Isolates", Agricultural Research Foundation, $5,500.00

Broders, K. D. (PI), Contract, "Plant Pathology - Wheat Plant Pathology Research and Extension Program", Colorado Wheat Administrative Committee, $17,860.00,

Broders, K. D. (PI), Contract, "Plant Pathology - Wheat Plant Pathology Research and Extension Program", Colorado Wheat Administrative Committee, $89,300.00

Byrne, P. F., Broders, K. D., Grant, "Exploring the microbiome of root, rhizosphere, and leaf of wheat and its relatives", Colorado Wheat Research Foundation, Colorado State University, $13,020.00

Dayan, F. E. (PI), Grant, "Analysis of Pesticide Residues and their Metabolites in Sugar Beet, Relevant Weeds and Soils", Western Sugar Cooperative, $5,000.00, Active. (start: January 1, 2016, end: December 31, 2016).

Gaines, T. A. (PI), Dayan, F. E. (CoPI), Cooperative Agreement, "Genomic Approaches to Study Metabolic Resistance in Dicots", Bayer Company, $89,451.00, Active. (sub: March 11, 2015, start: November 3, 2015, end: November 2, 2018).

Dayan, F. E. (CoPI), Grant, "Developing a Rapid Marker for a Novel Form of Glyphosate Resistance in Kochia", Western Sugar Cooperative, $12,000.00, Active. (sub: January 19, 2016, start: January 1, 2016, end: December 31, 2016).

Gaines, T. A. (PI), Contract, "Develop New Over the Top Grass Herbicide Resistance Traits in Sorghum using Mutagenesis", United Sorghum Checkoff Program, $30,000.00, Active. (sub: February 23, 2016, start: March 15, 2016, end: March 15, 2021).

Gaines, T. A. (PI), Westra, P., Contract, "Evaluate Dicamba Formulations for Control of Multiple Kochia Accessions from the Central Great Plains and Canada", BASF Corporation, $164,115.00, Active. (sub: June 20, 2014, start: May 1, 2014, end: April 30, 2018).

Gaines, T. (PI), Westra, P. (CoPI), Cooperative Agreement, "Develop Novel Traits in Sunflower Using Mutagenesis", BASF Corporation, $222,905.00, (sub: June 1, 2014, start: February 1, 2015, end: January 30, 2018).

Gaines, T. A. (PI), Westra, P. (CoPI), Cooperative Agreement, "Molecular Basis for Glyphosate Resistance and its Novel Rapid Necrosis Response in Giant Ragweed", Bayer Company,

$186,376.00, Active. (sub: September 4, 2014, start: January 30, 2015, end: January 29, 2018).

Gaines, T. A. (PI), Contract, "Develop Novel Traits in Sunflower Using Mutagenesis", BASF Corporation, $261,907.00, Active. (sub: July 30, 2014, start: October 1, 2014, end: September 30, 2017).

Gaines, T. A. (PI), Westra, P. (CoPI), Contract, "Develop Novel Traits in Sunflower Using Mutagenesis", BASF Corporation, $261,907.00, Active. (sub: October 26, 2015, start: October 1, 2014, end: September 30, 2017).

Gaines, T. A. (PI), Grant, "Developing a Rapid Marker for a Novel Form of Glyphosate Resistance in Kochia", Western Sugar Cooperative, $12,000.00, Active. (sub: January 19, 2016, start: January 1, 2016, end: December 31, 2016).

Gaines, T. A. (PI), Contract, "Weed Science Herbicide Resistant Weed Management in Winter Wheat", Colorado Wheat Administrative Committee, $30,000.00, Active. (sub: July 20, 2015, start: July 1, 2015, end: June 30, 2016).

Gaines, T. A. (PI), Westra, P. (CoPI), Nissen, S. J. (CoPI), Kniss, A. R. (CoPI), Grant, "EPSPS Gene Amplification in Controlling Glyphosate Resistant Kochia Research", Western Sugar Cooperative, $12,000.00, Active. (sub: February 24, 2015, start: January 1, 2015, end: December 31, 2015).

Gaines, T. A. (CoPI), Grant, "Analysis of Pesticide Residues and their Metabolites in Sugar Beet, Relevant Weeds and Soils", Western Sugar Cooperative, $5,000.00, Active. (start: January 1, 2016, end: December 31, 2016).

Nissen, S. J. (PI), Gaines, T. A. (CoPI), Thum, R. (CoPI), Grant, "Exploring the Physiological Basis of 2, 4-D Tolerance in Northern Watermilfoil x Eurasian Watermilfoil Hybrids", Aquatic Plant Management Society, $40,000.00, Active. (sub: April 15, 2014, start: January 1, 2015, end: December 31, 2016).

Nissen, S. J. (PI), Contract, "Improving Roadside Weed Management Through Site Specific Re-Vegetation, Training and Intra Agency Cooperation", Colorado Department of Transportation, State of Colorado, $43,848.00, Active. (sub: March 27, 2015, start: April 8, 2015, end: December 31, 2017)

Nissen, S. J. (PI), Contract, "Evaluation of Weed Control of BAS 820ABH", BASF Corporation, $4,422.00, Active. (sub: June 10, 2016, start: March 10, 2016, end: December 31, 2016).

Nissen, S. J. (PI), Grant, "Extending the Duration of Annual, Biennial, and Perennial Weed Control with Esplanade Tank Mixes", Jefferson County, Colorado, $15,100.00, Active. (sub: April 29, 2016, start: May 24, 2016, end: December 15, 2016).

Nissen, S. J. (PI), Contract, "2015-2016 Weed Seedling Identification Booklet and Associated Workshop", Tamarisk Coalition, $7,375.00, Active. (sub: May 22, 2015, start: June 22, 2015, end: May 31, 2016).

Nissen, S. J. (PI), Grant, "Evaluating New and Existing Herbicides for Downy Brome (Bromus tectorum) and Dalmation Toadflax (Linarea dalmatica) Control in Non-Cropland", Jefferson County, Colorado, $10,000.00, Active. (sub: April 28, 2015, start: May 29, 2015, end: December 15, 2015).

Norton, A. P. (PI), "Developing Mass Rearing Strategies for Rhinusa Linariae and Mecinus Janthinus", USDA-USFS-Forest Research, Federal, $24,800.00, Active. (sub: November 6, 2015, start: April 1, 2016, end: March 30, 2017).

Norton, A. P. (PI), "South Platte Phreatophyte Survey", Colorado Water Conservation Board, State of Colorado, $99,733.00, Active. (sub: March 19, 2015, start: April 2, 2015, end: December 31, 2016).

Norton, A. P. (PI), Cooperative Agreement, "Development of a Database: Biocontrol Agents of Insect Pests Released in the US", USDA-APHIS-Animal Plant Health Insp Srvc, Federal, $55,998.00, Active. (sub: June 25, 2015, start: September 30, 2015, end: September 29, 2016).

Norton, A. P. (PI), Contract, "CAPS: Collection and Redistribution of Biological Control Insects for the Control of Invasive Toadflax Species (Linaria spp.)", Colorado Department of Agriculture, State of Colorado, $15,962.00, Active. (sub: July 10, 2015, start: March 1, 2015, end: February 29, 2016).

Norton, A. P. (PI), Contract, "Effects of Russian Olive Removal on Soils and Understory Plant Communities in the Boulder Creek Floodplain, Boulder, Colorado", City of Boulder Open Space & Mountain Parks, $7,247.00, Active. (sub: September 9, 2015, start: August 13, 2015, end: October 31, 2015).

Holtzer, T. O. (PI), Jahn, C. E. (CoPI), Norton, A. P. (CoPI), Other, "Developing a Biological Control Strategy for Canada thistle", Ronald W. Miller and Diane Disney Miller Research, Education, and Engagement Project, $118,917.00, Funded. (start: August 15, 2014, end: August 14, 2017).

Norton, A. P. (CoPI), Jamieson, M. (PI), Bowers, D. (CoPI), Grant, "Impacts of Herbaceous Bioenergy Production Systems on Bee Communities: Implications for Pollinator Declines and Pollinator Conservation", USDA-NIFA-National Institute of Food and Agriculture, Federal, $499,998.00, Funded. (start: March 1, 2013, end: February 28, 2016).

Westra, P. (PI), Grant, "Agronomic Practices and Genetic Mechanisms Leading to Evolution and Spread of Glyphosate Resistance in Kochia", USDA-NIFA-National Institute of Food and Agriculture, Federal, $500,000.00, Active. (sub: June 8, 2011, start: March 1, 2012, end: December 31, 2016).

WERA 1017 2015-16 Report for Utah

Marion Murray and Diane Alston, Utah State University (USU)

ANNUAL REPORT

1st Area Addressed: **IPM in Specialty Crops (fruit, vegetable, nursery)**

Activity Outputs and Short-term Outcomes:

- IPM Advisories (free e-mail newsletters with advice on pest activity and IPM recommendations)
    - Fruits, Vegetables, Landscape Ornamentals, Turf (23 delivered in 2015)
    - Average about 8,000 subscriptions each
    - Content: scouting by IPM staff and volunteers; reports from growers
    - 350 archived advisories
- Utah TRAPs (Temperature Resource and Alerts for Pests, a web and mobile app pest management tool)
    - Access to 77 weather stations
    - 12 insect and disease models (fruit, ornamental, field crops)
    - Funding: grants, grower support, Utah Climate Center
- 2016 Vegetable production guide
    - 8 USU authors in 4 disciplines
    - 11 chapters: Cucurbits, Brassicas, Solanaceous, Sweet corn, Onion, covering production issues, soil/nutrient/water management, IPM, and pesticide safety
    - Funding: Specialty Crop Block Grant
    - 450 copies distributed to growers, plus free PDF available on IPM website
- Invasive Fruit Pest Guide
    - 5 authors from USU and Utah Department of Agriculture and Food covering brown rot, plum pox virus, spotted wing drosophila, brown marmorated stink bug, plum curculio, velvet longhorned beetle, and Japanese beetle
    - Funding: Specialty Crop Block Grant
    - 700 copies distributed for free to growers and for sale on USU Extension website, plus free PDF available on IPM website
- Intermountain Tree Fruit Production Guide (intermountainfruit.org), collaborative guide with USU, Colorado State University, and University of Idaho
    - New pesticide recommendation tables tied to database to allow for automatic updates
- Fruit PestFinder mobile app (free app for fruit Pest identification and IPM recommendations)
- New and Emerging Pests
    - Pear sawfly, *Hoplocampa brevis* found in commercial and backyard sites south of Salt Lake City
    - Sequoia pitch moth, *Synanthedon sequoiae*: killing pines in Salt Lake City area
- Applied Research
    - Survey of leafroller species in fruit orchards found that obliquebanded was the most predominant
    - Survey of potential wild fruit hosts for spotted wing drosophila (collaboration with University of Idaho)

- Testing different types of yellow sticky traps for optimal attraction and monitoring of western cherry fruit fly (collaboration with USDA ARS, Wapato, WA)
- Evaluating low-toxicity insecticides for control of western cherry fruit fly
- Testing a new codling moth biofix option by field-checking this insects' phenology in Utah
- Development of farmscape-based management strategies for onion thrips and Iris yellow spot virus in bulb onions
- Evaluation of biochar for enhanced vegetable production and protection and protection from root-rotting pathogens

Impacts:

- Utah TRAPs website and Advisories (fall 2014 survey with 18% response rate; next survey scheduled for fall 2016)
    - 100% plan to continue subscription
    - 87% use Utah TRAPs and advisories as main pest management resources
    - Pesticide change in the last two years:
        - 44% stopped using broad-spectrum insecticides,
        - 42% switched to using only soft/organic materials
        - 50% now apply a dormant spray, if needed
        - 6% are new adopters of mating disruption
    - IPM self-assessment:
        - 86% labeled themselves as users of IPM (61% Low IPM, 21% Medium IPM, and 4% High IPM)
        - Of those that ranked themselves as Medium or High, 59% would have ranked themselves as Low 2 years ago
    - Economic impact: Although 25% of High IPM vegetable producers reported increased costs, 33% also reported increased profits and none reported a decrease
- Utah TRAPs app:
    - In-app survey shows that the app is helping 93% of users to improve their pest management practices due to improved timing.

2nd Area Addressed: **IPM in Communities**

Activity Outputs and Short-term Outcomes:

- Community gardens, small acreage farms, organic farms, municipal landscapes
    - 15 presentations to community stakeholders
    - Over 500 community stakeholders received training in IPM practices for small-scale farm and garden production
- Collaboration with Utah Urban and Small Farms Conference, organized by USU Extension and multiple community partners; major funding comes from a USDA NRCS Risk Management Agency grant
    - The Utah IPM Program provides extensive input into conference planning and implementation; four IPM presentations were delivered in February 2016 reaching nearly 100 small acreage stakeholders
- Interpretative IPM signage

    - Two interpretative IPM signs were deployed at key public garden facilities in 2016: Utah State University Botanical Center in Kaysville, and Wheeler Historic Farm in Salt Lake City
    - Signs were positioned near gardens demonstrating IPM techniques
    - Official visitation numbers are not available, but each site receives an estimated 50-100 visitors per weekend during the growing season
- Raised bed demonstration and instruction conducted by an IPM mini-grant recipient (extension agent) funded jointly by USU IPM Program and Western Sustainable Agriculture and Education (WSARE)
    - Conducted hands-on workshops to teach raised-bed best management practices, including IPM, to 62 adults and youth

Impacts:

- Reduction in overall pesticide use due to education on IPM alternatives to prevent and reduce pest pressure
- Change in selection of broad-spectrum, higher toxicity pesticides to those with narrower-spectrum, lower toxicity
- Conservation of beneficial arthropods that assist with biological control
- Education of organic producers in IPM techniques, e.g., preventive pest tactics to reduce application of organic pesticides
- Education of youth and novice stakeholders in IPM practices
- Greater awareness of the IPM concept and how it can help improve community horticulture

3rd Area Addressed: **School IPM**

Activity Outputs and Short-term Outcomes:

- Assist with compliance for Utah's "School Rule" mandate
- Pest ID Handbook (print and website) in collaboration with Colorado State University
- Hands-on IPM workshops (150 participants) in 4 public school districts
- On-site inspections of 3 schools within each district,
- Targeted IPM plans to 8 schools

Impacts:

- Improved health of students and staff due to reduced indoor pesticide exposure
- Reduction of overall pesticide use due to changes in structural design and pest management plans
- Improved knowledge of school custodial staff in IPM techniques and how to explore alternatives to pesticides

4th Area Addressed: **IPM in Agricultural Crops (field and forage crops)**

- Comparison of methods for managing Townsend's ground squirrel in crop lands conducted by an IPM mini-grant recipient (extension agent) funded jointly by USU IPM Program and Western Sustainable Agriculture and Education (WSARE)
    - live bait-and-release showed that tube traps were most effective in reducing populations
    - conducted ground squirrel management workshop and field day to 75 participants
    - follow-up research will include improved timing of trap placement, cultural control activities, and use of biological control (owls, raptors)

Impacts:

- Commercial producers were trained in effective trapping practices for a tenacious pest of field crops, the Townsend's ground squirrel
- Education of novice stakeholders in IPM practices

PRIMARY LINKAGES INTERNAL TO WERA 1017

- Publication collaborations
    - Intermountain Tree Fruit Production Guide (intermountainfruit.org), collaborative guide with Utah State University, Colorado State University, and University of Idaho
    - School IPM Pest ID Handbook (print and website), collaboration with Colorado State University
- Applied research collaboration
    - Survey of potential wild fruit hosts for spotted wing drosophila (collaboration with University of Idaho)

PRIMARY LINKAGES TO EXTERNAL GROUPS

- Community IPM:
    - Strong collaborations with multiple county-based extension faculty in Davis and Salt Lake Counties (organic stakeholder trainings, IPM interpretative signs in public gardens, biochar research project)
    - Non-profit community garden organizations (staff and public training, pest monitoring sites)
- Invasive pest survey: strong collaborations between the Utah IPM Program and the Utah Cooperative Agricultural Pest Survey Program, responsible for surveillance of invasive pests in the state; we co-organize extension in-service and public stakeholder trainings and co-produce outreach publications (e.g., Utah Fruit Invasive Pest Guide)
- Utah Plant Pest Diagnostic Lab (UPPDL): the IPM Program coordinates with the UPPDL on diagnostics, trainings, development of IPM recommendations, and outreach publications (many fact sheets and other extension publications and online content are co-produced by staff from the IPM Program and UPPDL)

- Utah Department of Agriculture and Food: the Utah IPM Program coordinates and collaborates on numerous diagnostic and training activities each year, e.g., accurate identification of Sequoia pitch moth, pesticide applicator training workshops, etc.

GRANTS

USDA NIFA Specialty Crop Research Initiative (PD: Jim Walgenbach, North Carolina State University)

Alston, D. (PI) and L. Spears ($122, 380 for USU)

Management of brown marmorated stink bug in U.S. specialty crops

Sep 2016 – Aug 2021

Utah Department of Agriculture and Food – Utah Specialty Crop Block Grant Program

Alston, D. (PI) and M. Murray ($25,425)

Improving codling moth management by getting a better Biofix

Jan 2016 – Jun 2018

USU Extension Grant Program

Murray, M. ($10,000)

Improving delivery of pest management recommendations for Utah fruit growers

June 30, 2016 – July 1, 2017.

Utah Agricultural Experiment Station Seed Grant Program

Alston, D. (PI) and L. Spears ($55,000)

Brown marmorated stink bug: plant host utilization in diverse urban-agricultural landscapes and promoting biological control

May 2016 – May 2018

PUBLICATIONS

Journal Articles (Peer-reviewd)

Yee, W. L., Alston, D. G. (2016). Sucrose mixed with spinosad enhances kill and reduces oviposition of Rhagoletis indifferens (Diptera: Tephritidae) under low-food availability. *Journal of Entomological Science, 51*(2), 1-6.

Black, B. L., Lindstrom, T., Hunter, B., Olsen, S. H., Heflebower, R. F., Alston, D. G., Maughan, T. (2015). Adaptability of floricane-fruiting raspberry cultivars to a high-elevation arid climate. *Journal of American Pomological Society, 69*(2), 74-83.

Conference Papers and Presentations

Swain, A., C. Ransom, D. Alston, and C. Nischwitz. 2015. Influence of weed species on thrips and Iris yellow spot virus in onion. Proceedings of the Western Society of Weed Science 68 (September).

Extension Books

Cannon, C., B. Bunn, D. Drost, M. Murray, D. Alston, C. Nischwitz, M. Pace, B. Hunter, and T. Beddes, (2016). *Utah Vegetable Production and Pest Management Guide 2016* (2nd ed., pp. 206 pp.). Logan, UT: Utah State University Extension.

Cannon, C., D. Alston, C. Nischwitz, L. Spears, and C. Burfitt. 2016. *Invasive Fruit Pest Guide for Utah: Insect and Disease Identification, Monitoring, and Management* (1st ed., 102 pp.). Logan, UT: Utah State University Extension.

Extension Fact Sheets

Alston, D. G. (2015). *Rose stem girdler (Agrilus cuprescens)* (vol. ENT-178-15, pp. 1-4). Logan, UT: Utah State University Extension and Utah Plant Pest Diagnostic Laboratory. http://extension.usu.edu/files/publications/publication/ENT-178-15.pdf

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http://extension.usu.edu/files/publications/factsheet/ENT-179-15.pdf

Alston, D. G., Barbour, J. D., Steffan, S. A., Pace, M. (2015). In Elizabeth Beers (Ed.), *California prionus (Prionus californicus Motschulsky)*. Pullman, WA: Orchard Pest Management Online, Washington State University. http://jenny.tfrec.wsu.edu/opm/displaySpecies.php?pn=643

Hunter, B., Heflebower, R. F., Olsen, S. H., Black, B. L., Alston, D. G., Lindstrom, T. (2015). *A comparison of 16 summer-bearing raspberry cultivars for northern Utah* (Horticulture/Fruit/2012-02PR ed., pp. 6 pp.). Logan, UT: Utah State University Extension.

Alston, D. G., Murray, M., Barnhill, J. V. (2015). *Walnut Husk Fly [Rhagoletis completa (Cresson)]* (vol. ENT-173-14, pp. 7 pp.). Logan, Utah: Utah State University Extension. http://extension.usu.edu/files/publications/factsheet/walnut-husk-fly.pdf

Extension Newsletters

Utah Pests News quarterly newsletter, M. Murray, editor

http://utahpests.usu.edu/htm/utah-pests-news

Four issues annually (fall, summer, spring, winter)

Articles on timely pest management topics with great emphasis on the practice of IPM

The newsletter is distributed to the national USDA pest managers listserv

WERA 1017 Arizona State Report 2016

July 2015 – June 2016

Program Outcomes Summary:

Across all IPM program areas, we reached over 9,000 participants at 43 Cooperative Extension meetings and at industry conferences and university events, delivering 139.5 AZ CEUs, 57 CA CEUs, 11 Certified Crop Advisor CEUs and 49 CEUs from Office of Pest Management for urban pest management. These included several field days and research demonstrations for agricultural crops, pesticide safety, turf and school IPM.

Area Addressed: Vegetable IPM

Activities & Outputs:

The Vegetable IPM Team continued biweekly insect, weed and disease management Veg IPM Update advisories, delivering 23 IPM updates to over 800 people via web, email, smart phone and in audio file format. Updates were re-distributed by Western Farm Press and other mass media, reaching well over 10,000 readers. Dr. Palumbo published 15 articles in the ESA journal Arthropod Management Test. Recent Extension publications included: Insect and weed interactions in desert crops, and management guides for leafminer, thrips, aphids, and whitefly. (Selected examples under Products.) Extension trainings on specialty crops included a Citrus & Date Palm Seminar and Lettuce Pest Losses workshops. The Southwest Ag Summit reached about 800 participants, including pest management presentations and field demonstrations.

Outcomes:

A Vegetable IPM Team survey sent to over 800 end users (n=73) assessed clientele satisfaction, knowledge changes, adoption of reduced risk and resistance management practices, and impacts vegetable IPM practices on yields and economic returns.

- 98% of respondents said the Veg IPM Updates are helpful (32%) or very helpful (66%) for increasing their knowledge of new technologies in vegetable production.
- 53% said they learned “a great deal” about reduced risk chemistries and resistance management from the updates and 38% learned “a moderate amount”.

- 76% either agreed (51%) or strongly agreed (25%) that their pest management practices changed as a result of information provided in the Veg IPM Updates.
- 79% either agreed (36%) or strongly agreed (43%) that their reliance on broadly toxic pesticides has been reduced due to an increase in Vegetable IPM Knowledge.
- 79% either agreed (55%) or strongly agreed (24%) that their industry has adopted reduced risk practices due to the Vegetable IPM Team's activities.
- When asked, "How much have your yields and economic returns improved due to better Vegetable IPM Practices", 28% responded "much improved" and 54% indicated "somewhat improved." Only 18% of respondents said "about the same."

Area Addressed: Agronomic Crops IPM

Activities & Outputs:

We developed and deployed Chemical Use Maps for whitefly resistance management last summer, putting pesticide use maps for 6 modes of action into the hands of pest managers and conducting intense outreach on the "first principles" of resistance management. This effort is leveraged by USDA-NIFA-ARDP, Monsanto, the Specialty Crop Block Grant program and Cotton Inc. Research and outreach on the economics of brown stink bug management continued this term, leveraged by a Western IPM Center grant. New research results from a cost-benefit analysis were presented to 180 pest control advisors and other ag industry participants at the 2016 Desert Ag Conference. The Third Annual New Technologies workshop covered topics such as precision application technologies, implementation of biological control measurements for adjusting control decisions for whiteflies in cotton, UAV for plant disease scouting, and Dicamba and 2,4-D resistant cotton.

Outcomes:

Cotton IPM program: In 2012 and 2013 growers experienced, and treated, high levels of brown stink bug (BSB), a native, previously minor pest. We responded with research on the economics of BSB control in cotton, and showed that treatments (of any product tested) resulted in no additional benefits in yield, fiber quality, seed quality, or resulting alfatoxin levels, and higher costs to growers, averaging over $72 per acre. Spraying for BSB also resulted in a 33% increase in risk for spraying for resurgent whitefly populations and a 33% increase in risk for spraying secondary outbreaks of two-spotted spider mites, which also increased grower costs. In 2013, 39% of cotton acres were treated for BSB. After Extension presentations of this research early in 2014 and again in 2015, growers drastically backed away from use of pyrethroids and dicrotophos for stink bug control, many times opting not to treat it. In 2014, 6% of acres and in 2015 only 3% of acres were treated. Our preliminary analysis suggests that the economic savings to growers resulting from this change in behavior easily exceed $8 million.

Other Cotton Impacts

- Reductions in control costs & yield losses to arthropods have saved growers more than $451,000,000 since 1996, more than $10 million annually.
- Growers have reduced broadly toxic insecticides by 93%, comparing 2006-2014 to 1991-1995 levels; sprays for all insecticides have been reduced over the same period by 82%. 20% of 2014 cotton acreage was never sprayed for insect pests.

- Risks to human health and the environment have been reduced by preventing 21 million pounds of insecticide active ingredient from reaching the environment.
- In the border region of Mexico (pop. 1M), 30,000 ha of cotton has often been subject to broadly toxic pesticide use, affecting over 15,000 agricultural workers; implementation of the Arizona IPM program resulted in a 51%, 30–40%, and 34% reduction in broadly toxic insecticides, all insecticides, and their costs, respectively, saving over $1.6M in 2012 alone.

Area Addressed: Community IPM

Activities & Outputs:

The Community IPM Leadership Team directs program activities with the coordination of Dr. Shaku Nair. The team continued implementation of IPM pilot projects at 6 schools in 5 school districts. Through the Stop School Pests project funded by a US-EPA grant and leveraged through EIP, online training modules and a national certification program for IPM in Schools have been develop and posted online (http://cals.arizona.edu/apmc/StopSchoolPests.html). Other major efforts include bed bug research and IPM implementation in public housing environments funded through a USDA-NIFA ARDP grant. Published several important Extension publications on topics including Zika Virus, Mosquito Identification and Management, Bats, and on new invasive pest Ficus Whitefly. Our monthly newsletter for School and Home IPM is widely distributed by several regional and state partners, reaching over 4,000 people monthly. Members of our team serve as technical advisors for EPA regional and EPA School IPM Center of Expertise staff, and collaborative school IPM orgs.

Outcomes:

- Produced standardized curricula to train individuals in key school district job roles to achieve IPM performance objectives.
- More than 20 school IPM workshops/education events in Arizona (>9,000 K-12 students).

Elderly and disabled low-income housing sites adopting IPM:

- 78% reduction in German cockroach infested units based on visual inspection (preliminary estimate; final trap results in 6 weeks).
- 81.6% reduction in bed bug infested units based on visual inspection; final trap results in 6 weeks.
- Based on conversations, residents and staff much happier.
- 3 new housing staff.
- Pest management costs have increased significantly (amount to be determined in final analysis).

Area Addressed: Pesticide Safety

Activities & Outputs:

Dr. Mike Wierda, Assistant in Extension for Pesticide Safety Education, has focused on identification of pesticide safety training priorities and working with a stakeholder advisory team to find paths to sustainably for an ongoing PSEP (leveraged through a PSEP-IMI grant). In partnership with the state lead agency, Arizona Department of Agricultures, priority training resources have been identified and we are

pursuing possible ongoing funding mechanisms to accomplish these goals. This term, Dr. Wierda presented at 17 meetings on topics related to IPM and pesticide safety, including 2 large Earth Day events, reaching over 2,100 stakeholders. Mike serves on a state sub-committee that is revising urban pest control applicator certification exams for Arizona and also participates on a national committee of state PSEP personnel to remain aware of emerging resources and issues that may have relevance for Arizona.

Outcomes:

Through formation of a Stakeholder Advisory Team to develop a more sustainable and robust Pesticide Safety Education program, we have established new relationships with some stakeholder groups and improved collaboration with the state lead agency.

Publications

7/1/15 – 6/30/16

Peer Reviewed

Gouge, D. H. 2016. Working in a World of Bed Bugs. Journal of Environmental Management Arizona. Jun/Jul.: 5-6.

Gouge, D. H. and M. L. Lame. 2015. Environmental Health Professionals Work the Bugs Out - School Integrated Pest Management. Journal of Environmental Health. Journal of Environmental Health 77 (10): 42–44.

Misbah-ul-Haq, M., I. A. Khan, A. Farid, M. Ullah, D. H. Gouge, and P. B. Baker. 2016. Efficacy of Indoxacarb and Chlorfenapyr against Subterranean Termite *Heterotermes indicola* (Isoptera: Rhinotermitidae) in the Laboratory. Turkesh Journal of Entomology 40 (3): 227-241.

Naranjo S.E., S. Li. 2016. Long term dynamics of aphelinid parasitoids attacking *Bemisia tabaci, Biological Control.* Vol. 93, 5664. doi:10.1016/j.biocontrol.2015.11.010

Palumbo J.C. 2016. *Bagrada hilaris* Control with Conventional Insecticide Mixtures 2014*., Arthropod Management Tests.* Vol. 40 No. 1, 12. doi: http://dx.doi.org/10.1093/amt/tsv085

Extension Publications

General:

Fournier A.J., P.C. Ellsworth, N. Pier, W.A. Dixon II. 2016. Pesticide Use Data Why Getting It Right Matters. IPM Short. University of Arizona, Arizona Pest Management Center. http://ag.arizona.edu/crops/cotton/files/PesticideUseData.pdf

Gouge D.H., S. Li, S. Nair. 2015. Bats. Extension Publication. University of Arizona Cooperative Extension. Publication no. az1675 https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1675-2015.pdf

Gouge D.H., S. Nair, S. Li, T. Stock. 2015. Pest-proofing your home. Extension publication. University of Arizona Cooperative Extension. Publication no. AZ 1677 https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1677-2015.pdf

Gouge D. H., T. Stock, S. Nair, S. Li, S. Bryks, J. Hurley, A. J. Fournier. 2015. Generic School IPM Plan Template. University of Arizona Cooperative Extension AZ1669, pp. 12. *https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1669-2015.pdf*

Gouge, D. H., S. Li, K. Walker, C. Sumner, S. Nair, and C. Olson. 2016. Mosquitoes: Biology and Integrated Pest Management. University of Arizona Cooperative Extension AZ1706, pp. 12. *http://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1706-2016.pdf*

Gouge, D. H., T. Stock, J. Hurley, S. Nair, A. J. Fournier, S. Li. 2015. School IPM Plan Template for Tribal Communities. University of Arizona. pp. 55. *http://ag.arizona.edu/apmc/westernschoolIPM.html#pubs*

Guzy M., A.J. Fournier, P.C. Ellsworth, J.C. Palumbo, P. Jepson, W.A. Dixon II. 2015. ipmPRiMEorg: Making Informed Pesticide Use Decisions Based on Risk. Extension Publication. University of Arizona Cooperative Extension. Publication no. az1685

Li S., D. H. Gouge, A. J. Fournier, N. Pier, S. Nair. 2015. Bed Bug Information Card. University of Arizona. pp2. *http://cals.arizona.edu/apmc/docs/Bed-Bugs-Card.pdf*

Li S., D.H. Gouge, S. Nair, A.J. Fournier, M.R. Wierda. 2015. Head Lice: Identification Biology and Integrated Pest Management. Extension Publication. University of Arizona Cooperative Extension. Publication no. az1687 http://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1687-2015.pdf

Li S., D.H. Gouge, S. Nair, A.J. Fournier. 2015. Pesticide Resistant Head Lice September 2015. CALS Cooperative Extension. University of Arizona Cooperative Extension. https://extension.arizona.edu/sites/extension.arizona.edu/files/resources/Back-to-School-Head-Lice.pdf

Li S., D.H. Gouge, S. Nair, A.J. Fournier, U.K. Schuch, K. Umeda, D.M. Kopec, P.L. Warren. 2015. Mosquito-borne Diseases and Mosquito IPM. CALs Cooperative Extension. University of Arizona Cooperative Extension. https://extension.arizona.edu/sites/extension.arizona.edu/files/resources/Mosquito%20Information.pdf

Li S., D.H. Gouge, K.R. Walker, A.J. Fournier, S. Nair, M.R. Wierda, J. Hurley. 2016. The Zika Virus. IPM Short. University of Arizona, Arizona Pest Management Center. http://cals.arizona.edu/apmc/docs/Zika-virus.pdf

Matheron M.A. 2015. Biology and Management of Fusarium Wilt of Lettuce. no. August 2015 University of Arizona Cooperative Extension. Publication no. AZ 1678 No. AZ1678 http://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1678-2015.pdf

Nair S., D.H. Gouge, S. Li, P.C. Ellsworth, M.R. Wierda, A.J. Fournier. 2016. Why Pesticide Application Notifications in Schools Are Important. IPM Short. University of Arizona, Arizona Pest Management Center. http://cals.arizona.edu/apmc/docs/Pesticide_Notification_Schools.pdf

Nair S., D.H. Gouge, S. Li, P.L. Warren, A.J. Fournier, M.R. Wierda, K. Umeda, D.M. Kopec. 2016. Honey bees in community environments – Identification and biology. IPM Short. University of Arizona, Arizona Pest Management Center. http://cals.arizona.edu/apmc/docs/WildHoneyBeeIPM1.pdf

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Nair, S., R. Senior, K. Umeda, P. Ellsworth, U. Schuch, D. H. Gouge, S. Li. Identification and Biology of the Ficus Whitefly. 2015. University of Arizona. pp. 1. *http://cals.arizona.edu/apmc/docs/Ficus_Whitefly_Short1.pdf*

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Palumbo J.C. 2016. 2015 Guidelines for Whitefly / CYSDV Management in Melons. University of Arizona Cooperative Extension. Vol. 6 No. 14 http://ag.arizona.edu/crops/vegetables/advisories/docs/070815_2015_Whitefly_CYSDV_Management.pdf

Palumbo J.C. 2016. Bagrada Bug Management Tips 2015. University of Arizona Cooperative Extension. Vol. 6 No. 19 http://ag.arizona.edu/crops/vegetables/advisories/docs/091615_Bagrada_Bug_Management_Tips_VegIPMUpdate_Fall%202015.pdf

Palumbo J.C. 2016. Impact of Planting Date on Aphid Infestation and Contamination of Lettuce. University of Arizona Cooperative Extension. Vol. 6 No. 23 http://ag.arizona.edu/crops/vegetables/advisories/docs/111115_Lettuce_Planting_Date_Impact_on_Aphid_Species.pdf

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http://ag.arizona.edu/crops/vegetables/advisories/docs/012016%20Seed%20corn%20maggot%20in%20spring%20melons%202016.pdf

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http://ag.arizona.edu/crops/vegetables/advisories/docs/031616_Insecticide_MOA_groups_Vegetables_Mar2016.pdf

Palumbo J.C. 2016. 2014-15 Insecticide Usage on Arizona Lettuce. Vegetable IPM Update. University of Arizona Cooperative Extension. Vol. 7 No. 8
http://ag.arizona.edu/crops/vegetables/advisories/docs/061015_Insecticide_Usage_Summary_in_Lettuce_2015.pdf

Palumbo J.C. 2016. 2015-16 Insecticide Usage on Arizona Lettuce. Vegetable IPM Update. University of Arizona Cooperative Extension. Vol. 7 No. 12
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http://ag.arizona.edu/apmc/docs/16EPA-Sulfoxaflor-In-ArizonavFv2.pdf

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http://www.westernipm.org/index.cfm/about-the-center/publications/special-reports/western-ripm-retrospective-full-pdf/

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Videos, Webinars, Online Presentations (Selected)

Ellsworth P.C., A.J. Fournier, T. Vandervoet, S.E. Naranjo. The Arizona Whitefly IPM Model: Cooperative Extension as Key to Translating and Transforming the Mexican Cotton System. Presented at 2nd International Whitefly Symposium Arusha Tanzania Africa, 02/18/2016. 130 participants.
http://ag.arizona.edu/crops/presentations/2016/15Arusha%20IWS%20Mexico%20EPAvFlo.pdf

Fournier A.J., P.C. Ellsworth, W. Dixon. Better Pesticide Use Data Means Better Resources for Growers. Presented at multiple locations.
http://ag.arizona.edu/crops/presentations/2016/1080_issues_ChemUseMaps_v3_notes_VF.pdf

Gouge, D. H., S. Li, S. Nair, K. Drake. Bed Bugs in Elderly and Disabled Low-income Housing – Getting Real! Enhancing Environmental Health Knowledge (EEK): Vectors and Public Health Pests Virtual

Conference, *http://www.neha.org/news-events/community-calendar/eek-vectors-and-public-health-pests-virtual-conference*. April 13, 2016. 60 views.

Li, S., D. H. Gouge, A. J. Fournier, T. Stock, A. Romero, D. Young, S. Nair, C. Foss, R. Kerzee, D. Stone, M. Dunn. Bed Bug (*Cimex lectularius* L.) Infestations Impact Quality of Life. Enhancing Environmental Health Knowledge (EEK): Vectors and Public Health Pests Virtual Conference, *http://www.neha.org/news-events/community-calendar/eek-vectors-and-public-health-pests-virtual-conference*. April 13, 2016. 44 views.

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Ellsworth, P.C. 2015-2018. $324,375 Crop Pest Losses & Impact Assessment and Regional Comments Coordination for Southwest. Western IPM Center Signature Program (subaward), USDA-NIFA Crop Protection and Pest Management Program.

Ellsworth, P.C., J. Palumbo, Y. Carriere, A. Fournier, W. Dixon, L. Brown., S. Castle, N. Prabhaker. "Prospective" Resistance Management: Empowering Growers to Understand and Exploit Refugia. 2015-2017. $424,325 Monsanto Insect Knowledge Management Program.

Ellsworth, P.C., N. Prabhaker, S. Castle, J. Palumbo, Y. Carriere, A. Fournier, W. Dixon, L. Brown. "Prospective" Resistance Management: Empowering Growers to Partition Chemistry in Space and Time. 2014-2017. $250,000 USDA-NIFA, Crop Protection and Pest Management (CPPM) Applied Research and Development Program (ARDP).

Fournier, A., P.C. Ellsworth, W. Dixon, J. Palumbo & L. Brown. 2015-2017. Grower Tools to Manage Pesticide Resistance. $112,901. USDA-AMS, Arizona Department of Agriculture, Specialty Crops Block Grant.

Gouge, D. H., T. Green, A. Fournier, S. Li, S. Nair, D. Kopec, P. Baker, K. Umeda, C. Foss, T. Stock, S. T. Ratcliffe. 2014-2016. Building sustainable school IPM inside and out: Developing and implementing standardized training materials and IPM proficiency exams for certification. $250,000. US-EPA.

Gouge, D. H., S. Li, A. Fournier. 2014-2017. National assessment of bed bug impacts and demonstration of IPM in high-risk elder/disabled housing facility, $124,999. USDA-NIFA, Crop Protection and Pest Management (CPPM) Applied Research and Development Program (ARDP).

WERA-1017 report - MONTANA

Area addressed - Agronomic Crops

Activities: Real time monitoring of pests via a website - pestweb.montana.edu

Outputs: The PestWeb (pestweb.montana.edu) system was used to track populations of the orange wheat blossom midge, alert growers to pest populations, and as a venue for education of growers for IPM for insect pests.

Short-term Outcomes: In the last year there have been 5176 sessions on the website with 17,407 page views. 73% are new visitors and the average length of time spent per page is 2 minutes.

Impacts*:* The high percentage of new visitors indicates that the website is providing useful information to growers.

Area addressed - Agronomic Crops

Activities: Montana AgAlerts and Urban Alerts email alerts, text notifications, and Facebook page

Outputs: Approximately 70 AgAlerts were issued during the year. Text alerts were added to the Montana AgAlert system (mtagalert.org, 880 email, and 40 text subscribers) and Urban Alert (mturbanalert.org, 139 email, and 8 subscribers) system for those preferring text communication rather than email. A Facebook page for the Schutter Diagnostic Laboratory was started with almost 200 likes.

Short-term Outcomes:

In the last year there have been 18,095 sessions on the AgAlert website with 42,620 page views with 38% new sessions.

On the urban alert website, there were 3128 sessions with 4995 page views and 77% new visitors.

Our Facebook page had a total reach of 14,650 on 43 posts this year.

Impacts*:*

The high number of sessions and page views could indicate that users find the AgAlert website is useful and valuable as a source for information and return frequently to view the updates.

Area addressed - Agronomic Crops

Activities: Presentations, TV appearances, workshops related to agronomic IPM.

Outputs: 41 workshops/presentations with 2813 participants. Three appearances on "Montana AgLive" (TV show) which reached approximately 30,000 people. Three newspaper articles. One refereed journal publication.

Short-term Outcomes:

Impacts*:*

Publications: Burrows, M., C. Thomas, N. McRoberts, R. Bostock, L. Coop, J. Stack. 2016. Coordination of Diagnostic Efforts in the Great Plains: Wheat Virus Survey and Modelling of Disease Onset. Plant Dis. (in press, Feature Article, First Look).

Area addressed - Communities

Activities: Montana Noxious Weed Realtor Training Course

Outputs: The Montana Noxious Weed Realtor Training Course was launched in the fall of 2015 through the online platform Digital Chalkboard. This module–based program provides training on how to identify Montana noxious weeds and resources for treating them. Realtors receive continuing education credits for completing the course. To date 22 individuals have taken the course.

Short-term Outcomes: Results for participants completing the course through July 2016 indicate that 95% thought the course adequately addressed the topic of noxious weed identification and management. Sixty-four percent said that noxious weeds are a problem on the properties they list in Montana. All agreed that the course increased their knowledge, ability to inform clients of noxious weeds, and ability to recognize noxious weeds on the properties they list.

A Likert scale was used to collect the "Level of Awareness" about Montana noxious weeds from participants. Before taking the Montana Noxious Weed Realtor Training course participants' average rating was 2.9 out of a 4 point scale. More specifically, 24% of participants reported to be "very aware" of noxious weeds prior to the training course, 57% "aware", 5% "unaware", and 14% "very unaware". The above data indicates that around 75% of participants to date are reasonably aware of noxious weeds.

After taking the course levels of agreement were very high to the following statements:

- I know where to direct clients for appropriate resources about noxious weed management. (80% strongly agree)
- I am more likely to inform clients about noxious weed issues on properties I list. (85% strongly agree)
- I am able to recognize noxious weeds on properties I list. (47% strongly agree)
- I am more informed about laws pertaining to noxious weeds. (79% strongly agree)

Impacts*:*

- **Results show that BEFORE taking the course 45% of the participants** have

informed/directed clients to resources about noxious weeds on properties. **Results indicate that AFTER completing the course 85% of the participants** do/will inform/direct clients (sellers/buyers) to resources about noxious weeds on properties. The participants indicated that they do or will inform clients of appropriate noxious weed resources.

- A follow up survey of participants will be conducted in the fall 2016 to determine to what extent the knowledge from the course was used in conducting real estate transactions.

Area addressed - Communities

Activities: Bed Bug workshops

Outputs: Two workshops on Bed bugs with 110 participants were presented during the reporting period.

Short-term Outcomes: A post-workshop online survey of participants at one of the workshops was administered two weeks following the workshop with a 44% response rate. Participants were most confident in their awareness of resources to help with bed bug infestation (4.53 on a 5.00 Likert scale). They were least confident in their ability to treat bed bugs (3.85) Participants were generally confident in their ability identify a bed bug (4.15), what steps to follow if they find a bed bug (4.41) and how to identify bed bug damage and infestation (4.41). Participants were less enthusiastic about further training on bed bug detection (3.41) perhaps because it was covered thoroughly in this workshop.

Impacts*:*

For future training, participants are most interested in:

- Prevention
- Legal Issues/Owner responsibilities
- Treatment

Area addressed - Communities

Activities: Emerald Ash Borer workshops

Outputs: Six workshops administered across Montana with 82 participants

Short-term Outcomes: A level of agreement scale was used to collect information about participant confidence in identifying the EAB beetle, ability to identify symptoms of EAB infestations and understanding about treatment options. Participants were most confident in understanding treatment options for EAB (4.40 on a 5.00 Likert scale). They were least confident in their ability to identify EAB beetles (4.00). Participants were confident in their ability to identify symptoms of an EAB infestation (4.05), how to conduct destructive tree sampling to check for EAB (4.35) and understanding treatment options for EAB. (4.40).

Impacts*:* The workshops resulted in increased awareness of Emerald ash borer. Participant level of awareness of Emerald ash borer increased by 2.25 points, from 2.30 to 4.55 on a 5-point scale, with 1 as “poor” and 5 being “excellent”.

Area addressed - Communities

Activities: Phragmites first detector training

Outputs: Five workshops and presentations administered across Montana with 280 participants

Impacts*:* The workshops resulted in increased awareness of non-native Phragmites australis in Montana.

Area addressed - Communities

Activities: Master Gardener training

Outputs:

Short-term Outcomes: A survey was sent to the list serve of Master Gardeners in the fall of 2015. There were 178 responses to the survey which asked about understanding and knowledge increases as a result of participation in the program. Before participating in the Master Gardener program participants' average level of understanding from novice understanding (1) to expert understanding (5) about the topic is 2.08. After participating in the Master Gardener program the average level of understanding increases by 1.65 points for a 3.73 average rating.

Impacts*:* In response to the specific topics of use in the Master Gardener training, the highest rated implementation of effective practices included "Practiced cultural (non-chemical) methods for managing pests" (71.7%) and "Develop a planting plan for my vegetable garden, which includes crop rotation" (70.4%). Overall, ninety-eight percent (98%) of respondents are "Somewhat likely" to "Very likely" to use something learned from the Master Gardener program.

Area addressed – Pest Diagnostic Facilities

Activities: Schutter Diagnostic Laboratory

Outputs: The Schutter Diagnostic Laboratory (SDL) at Montana State University (MSU) is provided as a service to the citizens of Montana through MSU and MSU Extension to provide plant pest identification.

Short-term Outcomes: The SDL conducted a total of 3562 plant disease, insect, and plant identification diagnoses from July 1, 2015-June 30, 2016. 1048 participants reached through 26 workshops/presentations about the Diagnostic Lab. 1 refereed journal article; 2 newspaper articles; 3750 through social media; 1 TV news feature

Impacts*:* Some specific impacts include:

- Savings of millions of dollars of malt barley potentially at risk due to diagnosis of Fusarium Head Blight.

- "The samples identified the problem as frost and drought so we saved the cost of fungicide application which saved approximately 35,000 dollars."
- A record high of 89 samples were submitted for diagnosis of wheat streak mosaic virus in 2015. Respondents to a survey (30 of 58 contacts) indicated the disease affected 159,310 acres and yields ranged from 25-150% of expected, with a mean of 85%. At an average yield of 45 bu/a and a price of $6/bu, this represents an estimated loss of $6.45 mil on those acres. Respondents increased their knowledge of wheat viruses (96%), and efforts to eliminate the green bridge for disease management increased in 92% of respondents. The majority (76%) reported that acres affected by viruses decreased due to SDL services.
- A solid phase immunoassay is currently being developed by engineering students at MSU. We expect to distribute up to 10,000 to faculty and agricultural professionals including Extension agents in multiple states and Canada for diagnosis in spring of 2016.
- A grower did not spray fungicide on a wheat crop with physiological spotting and saved $50,000 in applications costs with no observed loss in yield.
- The SDL helped to save thousands of dollars in the hospitality industry through identification and education of bed bugs and other pests.
- An estimate of the economic impact of the SDL in 2015 is over $2 million based on 489 responses to a survey. This number reflects direct economic impacts of diagnoses.

Area addressed – IPM Education for Pesticide Applicators

Activities: Pest Management Tour

Outputs: 304 people participated in the workshops given on the tour.

Short-term Outcomes: Fifty surveys were received by participants with 100% indicating an increased level of knowledge about pest management as a result of their attendance. . After the Pest Management educational event, 98% of the participants reported that they will utilize IPM practices in the future as a result of what they learned at the workshop. A Likert scale was used to collect the increase in the "Level of Knowledge" about pest management from participants as a result of attending the workshop. All of the participants reported that the workshop increased their knowledge of pest management (e.g. increase of knowledge of pest management was reported to be 4% a little, 29% some, 65% quite a bit, and 2% extremely). Similarly, a Likert scale was used to collect the participants' increase in confidence and ability to adopt IPM practices after attending the Pest Management workshops. All of the participants reported that the workshop increased their confidence and ability to adopt pest management practices in the future (e.g. increase of confidence and ability to adopt IPM practices was reported to be 2% a little, 3% some, 63% quite a bit, and 2% extremely).

Impacts*:* Some specific impacts include:

- The average number of acres the participants were responsible for was 4502 with a total of 153,062 and a total of 1750 head of livestock.
- The participants commented on their estimate of the calibration kits economic impact in regards to the kits potential to add economic value to a business and/or to the applicators. Responses included: "Approx. $5/acre for calibrating", "The kit will make presenting calibration much easier and the applicators will benefit through greater efficacy with the pesticides they use", "I anticipate calibration kits help producers use their equipment and pesticides safely and more efficiently thereby saving them approximately $10/acre in either under applied or over applied products", "I know it will help save several producers money by helping them apply correctly",

"$11/acre", "Savings per person (time, chemical) approximately $25 x number help calibrate (50) = $1250", "Save $ by using only as much chemical as needed". These estimates indicate significant savings over many acres.

Area addressed – IPM Education for Pesticide Applicators

Activities: Spray Calibration Kit Training - A survey was developed to assess participant response to the training sessions titled: "Tips on Teaching Calibration to Farm Applicators and Using Technologies when using Calibration Sprayers" (presented by Cr. Cecil Tharp, MSU Pesticide Education Specialist) during the 2016 MSU PEP Update on April 22, 2016 in Bozeman, MT.

Outputs: other workshops on pesticide application including calibration kits

304 people participated in the workshops given on the tour.

Short-term Outcomes: A Likert scale was used to collect the "Level of Ability" to teach the concept of calibrating ground sprayers using shortcut methods from participants. Before taking the course the majority of participants' average rating was 1, 2, or 3 out of a 5-point scale (i.e. 1= "poor" knowledge to 5 = "excellent" knowledge). The post survey revealed that the respondents' ability to teach calibration improved to 3, 4, and 5 on the 5-point Likert scale. Applicators are for the most part fairly knowledgeable in the first place in regards to their understanding of calibrating ground sprayers. However, ***there was an improvement in their ability to teach calibration following this informative session*** (i.e. participants moved from "fair/mediocre" to "good and excellent" in regards to the Likert ability scale. 82% agreed that the workshop increased their knowledge of calibration; 71% agreed that this workshop increased their confidence in teaching others about sprayer calibration. 76% agreed that the workshop increased their understanding of hands-on training. 76% agreed that they are confident they can determine the amount of pesticide product to add to the spray tank. 77% agreed that they know how to test the uniformity of nozzles. 65% know what adjustments to make to fine tune the gallons per acre spray distribution.

Impact: a follow up with users who received a spray kit will be conducted in the fall 2016.

Alaska, Agriculture and Horticulture

Peer Reviewed Extension Publications

Graziano, Gino. 2016. Control of Orange Hawkweed (*Hieracium aurantiacum*). Invasive Plant Issues, University of Alaska Fairbanks Cooperative Extension Service Publication.

Matney, Casey. 2015. Contributing Editor. Chapter 13, Berries. In: Alaska Master Gardening Manual, University of Alaska Fairbanks Cooperative Extension Service.

Matney, Casey. 2015. Contributing Editor. Chapter 12, Home Orchards. In: Alaska Master Gardening Manual, University of Alaska Fairbanks Cooperative Extension Service.

Matney, Casey. 2015. Contributing Editor. Chapter 11, Woody Landscape Plants. In: Alaska Master Gardening Manual, University of Alaska Fairbanks Cooperative Extension Service.

IPM in Local Communities

- Small acreage
- Field survey and community response to spruce aphid reports on the Kenai Peninsula (presence of spruce aphid on the peninsula is a new occurrence).
- Surveys of private lands. Interviews with local Newspapers.
- Collaboration with USDA Forest Service and Alaska Division of Forestry.

IPM in Native Communities

- Small acreage
- 8 presentations to four Native communities on Kodiak Island to develop rural agriculture including a week long field tour of agricultural farms on the Kenai Peninsula
- 10 or more trainees present at each presentation and field tour

IPM across Region

- Presentations to Garden Clubs, Farm Bureau, and Local/Regional Workshops
- Small acreage and larger farms
- 4 presentations ranging from pasture management to garden management.
- Over 100 participants.

IPM Community Response

- Small acreage and Larger Farms
- Providing Information based on community questions and individual requests (tree pests, home pests, garden and crop pests)
- Over 100 individuals

WERA-1017 State Report for Guam

IPM Coordinator: Robert Schlub

Actual Reporting Period: 09/2015 – 06/2016

Area Addressed: Urban and Community, Production Agriculture and Natural Ecosystems

Activity 1: Education of new stakeholder communities

Outputs:

- Manned an all-day interactive display at the University of Guam (UOG) Charter Day March 2016. Subjects covered included plant disease plant pests and the use of a stereo microscope
- Handouts were made available on the following subjects: Plant Disease, and Plant Pests
- Students had the opportunity to use a sterile microscope

Short-term Outcomes:

- Increased awareness of the 500 attendees of the interactive display

Impacts:

- Improved stakeholders' knowledge of plant diseases and pests
- Improved stakeholders' awareness of agencies that can provide information on plant pests and diseases

Activity 2: Education of pest identifiers and first responders

Outputs:

- Conducted a 3 ½ day Plant Diagnostic workshop in May 2016 which included first responder and invasive species training.

Short-term Outcomes:

- Increased number of pest identifiers and first responders
- 18%+ gain in knowledge by the 13 Agricultural Professionals from Guam and the Commonwealth of the Northern Mariana Islands

Impacts:

- Reduced impact of invasive species to our nation's natural resources and ecosystems through greater awareness

Activity 3: Updated vegetable production guides with current IPM practices

Outputs:

- Second edition of the 2002 "Eggplant, Pepper, and Tomato Production Guide for Guam" was placed on the University of Guam website on July 2016 (http://cnas-re.uog.edu/people-entry/eggplant/)

Short-term Outcomes:

- The second edition provided users with additional information on 4 new diseases, a new tomato variety field trial, and symptom production as displayed in 11 new color photos.

Long term Outcomes:

- Practitioners are afforded the opportunity to acquire new skills to implement targeted IPM strategies using new technologies, including reduced risk pesticides, cultural practices, and biocontrol.

Impacts:

- Improved communication and collaboration among University of Guam Cooperative Extension personnel and Guam tomato producers. Regarding Guam's strain of Tomato Ageratum Yellow Vein Virus (AYVV).

Activity 4: Support Pest Diagnostics – Provided onsite diagnostic advice to 730 clients and laboratory analyses of 198 plant disease samples

Outputs:

- Guam Plant Health and IPM Center/ University of Guam Extension and Research's 2015 Western Pacific Tropical Research Center Impact Report (http://cnas-re.uog.edu/wp-content/uploads/2015/09/2015impactweb.pdf)

Short-term Outcomes:

- Enhanced Pest Diagnostics responsiveness for clients and stakeholders

Impacts:

- Reduced negative impacts of invasive species through earlier detection

Extension Publications

- Second edition of the 2002 “Eggplant, Pepper, and Tomato Production Guide for Guam” was placed on the University of Guam website on July 2016 (http://cnas-re.uog.edu/people-entry/eggplant/)
- Robert Schlub and Sheeka Tareyama. 2015: Testing for virus-resistant tomato plants. University of Guam Western Pacific Tropical Research Center 2015 Impact Report (http://cnas-re.uog.edu/wp-content/uploads/2015/09/2015impactweb.pdf)

IPM Linkages with the 3 ½ day Plant Diagnostic workshop in May 2016

- Western Sustainable Agriculture Research and Education (WSARE) Professional Producer program provided the majority of the funds for the workshop
- National Plant Diagnostic Network
- Guam Cooperative Extension

WERA 1017 2015-16 Report for Hawaii

Andrea Kawabata (University of Hawaii CTAHR)

ANNUAL REPORT

IPM in Specialty Crop (coffee, tropical fruit and macadamia nut) Production Agriculture

Activity Outputs and Short-term Outcomes:

- 28 outreach events with coffee berry borer IPM information (workshops, seminars, field days, conferences, expos, etc.)
- 2 outreach events with macadamia felted coccid IPM information (workshop and conference)
- IPM Advisories (free e-mail and mail newsletters with advice on pest activity and IPM recommendations)
    - Coffee, Tropical Fruits and Macadamia Nut (12 delivered in 2015)
    - Average about 1,160 subscriptions each
    - Content: IPM educational events, agricultural announcements, farm and cultural practice advisories (pest, disease, propagation, fertilization, etc.)
    - 37 archived advisories
- Online sources of information
    - http://hawaiicoffee.weebly.com/
    - Content: CBB IPM, agricultural events and announcements, predators of CBB, coffee pests and diseases, publications and presentations
    - 600 views per week
    - http://ctahrmacadamia.weebly.com/
    - 100 views per week
    - Content: Crop cultural information, pests and diseases, crop research, food safety
- Strong collaboration with USDA ARS DKI PBARC and HDOA; major funding from a USDA ARS, HDOA and CTAHR
- Applied Research
    - Evaluation of controlling coffee berry borer on a micro scale using beneficial active microoganisms and Botanigard ES (*Beauveria bassiana* strain GHA)
    - Survey of the effect of CBB on the flavor and consumer preferences of brewed coffee

Impacts:

- 621 coffee growers directly educated
- 5,500 coffee growers and community indirectly educated via educational booths
- 2015 coffee berry borer survey (n=54)
    - 72% of growers have adopted field sanitation to control CBB in the field
    - 40% of growers have adopted the 30 trees sampling method for CBB monitoring
    - 90% of growers have adopted spraying *Beauveria bassiana* every 4 weeks to control CBB in the field
    - 86% of growers receive CBB IPM information from UH CTAHR
- Coffee event evaluations (n=247)
    - 92% of respondents increased their knowledge and understanding of CBB IPM and other topics presented

    - 91% of respondents learned at least one thing that was applicable to their operation or work.
- 47 macadamia growers directly educated
- 125 macadamia growers and community indirectly educated via educational booth
    - Over 500 community stakeholders received training in IPM practices for small-scale farm and garden production
- Macadamia event evaluations
    - 100% of respondents (n=19) increased their knowledge and understanding of Macadamia Felted Coccid
    - 89% of respondents (n=19) learned new ways to manage this pest.
    - 100% of respondents (n=16) learned at least one thing that was applicable to their operation or work.

GRANTS

Cho, A.H., M.G. Wright, and A.M. Kawabata. Canopy modification for macadamia felted coccid management in macadamia nut orchards in Hawaii. Western Integrated Pest Management Center. (03/01/2016 - 02/28/2017). $27,282.

Kawabata, A.M. and A.H. Cho. Hands-on training for tropical fruit, nut and orchard crop producers on sustainable farming techniques and practices. UH CTAHR Extension Supplemental. (10/01/2015 - 09/30/2017). $50,000 ($25,000/year).

Kawabata, A.M. and P.A. Follett. Predation by flat bark beetles on coffee berry borer. Hawaii Department of Agriculture. (06/15/2015 - 06/14/2016). $52,080.

Leung, P.S., A.M. Kawabata and S.T Nakamoto. Area-wide mitigation and management for coffee berry borer control - economic analysis. USDA-ARS Pacific Basin Agricultural Research Center. (09/01/2015 - 08/31/2016). $50,000.

Kawabata, A.M. Area-wide mitigation and management for coffee berry borer control - outreach and education. USDA-ARS Pacific Basin Agricultural Research Center. (09/01/2015 - 08/31/2016). $53,021.

PUBLICATIONS

Journal Articles (Peer-reviewed)

Follett, P.A., A. Kawabata, R. Nelson, G. Asmus, J. Burt, K. Goschke, C. Ewing, J. Gaertner, E. Brill, and S. Geib. (2016). Predation by flat bark beetles (Coleoptera: Silvanidae and Laemophloeidae) on coffee berry borer (Coleoptera: Curculionidae) in Hawaii coffee. *Biological Control*, 101, 152-158.

Conference Papers and Presentations

Brill, E., P. Follett and A. Kawabata. 2016. “Reproduction, feeding, and ecology of predatory flat bark beetles in a scolytine-infested agricultural landscape.” 100th Annual Meeting of the Pacific Branch of the Entomological Society of America, Honolulu, Hawaii (April 5, 2016).

Kawabata, A. 2016. Weebly’ve in Hawaii coffee: The internet at your fingertips. Coffee Berry Borer Conference, Kona, Hawaii (March 16, 2016).

Kawabata, A. and **R.T. Curtiss**. 2016. Controlling Coffee Berry Borer on a Micro Scale. Coffee Berry Borer Summit, Hilo, Hawaii (March 15, 2016).

Kawabata, A. 2016. UH CTAHR 2015-2016 CBB educational outreach efforts. Presented at Coffee Berry Borer Summit, Hilo, Hawaii (March 15, 2016).

Woodill, A.J., S.T. Nakamoto, A.M. Kawabata, and P.S. Leung. 2016. Decision Tree analysis of coffee berry borer in Hawai'i. Coffee Berry Borer Summit, Hilo, Hawaii (March 15, 2016).

Woodill, A.J., S.T. Nakamoto, A.M. Kawabata, and P.S. Leung. 2015. “Decision tree analysis of coffee berry borer in Hawai’i.” Seminar in Energy and Environmental Policy, Honolulu, Hawai'i (November 2, 2015)

University of Hawai`i Extension Implementation Program

2016 Summary

Arnold H. Hara

Accomplishments and Impacts

In 2015-16, four nurseries in East Hawai`i island regularly used hot water as a pre-shipment quarantine treatment. Approximately 135,791 plants were treated in the 12-month period, resulting in disinfestation of 3,635 coqui frogs and 61 other pests (slugs, snails, lizards, arthropods). Indications that adoption of a systems approach to pest management results in a lower pest load on plants prior to shipment were supported by continued decline (4.23%) in number of pests per treated plant from the previous reporting period.

The PI’s expertise was requested by University of California County Extension in fabricating a hot water shower for treatment of incoming plant material, and also by Mauna Kea Resorts Landscaping for entry point quarantine and treatment of nursery plants used at the resort (hotel and residential areas). The PI has worked with Christmas tree growers and shippers in Oregon and researchers at Washington State University and Oregon State University, to construct and operate a hot water shower facility to treat harvested trees for slugs and snails prior to shipment to Hawai`i.

Outreach to ornamental plant growers and shippers and to the general public was accomplished by one-on-one interactions with office drop-ins, phone calls, e-mails, and site visits, and presentations, educational displays and booths, including Big Island Association of Nurserymen (BIAN) Plant Sale (April 15-16, 2016, Hilo, HI – 10 hours of one-on-one interactions) and Hawai`i Island Master Gardeners' Plant Sale (April 30, 2016, Hilo, HI), to assist with pest identification, pinpointing site and mode of entry, provide recommended control strategies, and to increase awareness of their role in detecting and reporting alien species. UH CTAHR's website for the Control of Coqui Frogs in Hawai`i continues to generate phone calls from the public (in-state, out-of-state) to this project's personnel.

We collaborated with other agencies, including Hawai`i Ant Lab (HAL), Big Island Invasive Species Committee (BIISC), and Hawai`i Department of Agriculture (HDOA) Plant Quarantine Branch, sharing research results and pest control recommendations, and discussing outreach plans and production of resource materials. For example, BIISC requested feedback on a calendar template intended as a guide for LFA bait applications after individuals completed one of HAL's monthly Ant Management Clinic sessions. Our suggestions were: 1) to emphasize the importance of regular monitoring for LFA so that baits are applied "as needed", as opposed to applications by "calendar" *(depending on survey results, if LFA are detected, the interval between product applications can be 5-6 weeks, but no sooner than 4 weeks and no later than 6 weeks)* to decrease the development of insecticide resistance and bait shyness, and is more conscious of environmental as well as financial impacts, 2) provide a list of "toxicant baits" and "IGR" products with their unique EPA identifier number, and leave the selection of specific products up to the individual, 3) clarify the interval between alternating among different baits according to active ingredient, and refer to the product label, which limits the number of times a bait can be applied in a 12-month period, 4) look into software apps that can send out text reminders to smartphones or by e-mail to augment monitoring and bait application calendars, and finally 5) instead of a "one size fits all" calendar template, it may be necessary to design several to address common scenarios, e.g., an area with frequent re-infestations requiring aggressive approach as compared to an LFA-free area aimed at prevention.

Several video presentations on Best Management Practices for the most commonly intercepted pests of plant material shipped from Hawai`i have been produced and are available for viewing at http://www.ctahr.hawaii.edu/haraa/videos.asp

Publications

Coqui Frog Control for Homeowners. A.H. Hara and R. Niino-DuPonte (eds.). 2016. Office of Communication Services, CTAHR, UHM. CTAHR publication MP-5 (rev. May 2016).

Video Presentations

Hara, A.H. R.Y. Niino-DuPonte, S.K. Cabral, K.L. Aoki, and J.A. Zarders. 2015. Shipping pest-free plants and plant products to California: Exporting pest-free plant products from Hawai'i. Part I: Understanding Regulations and Inspection. CTAHR, UH Mānoa, Komohana Research and Extension Center, Hilo, HI. http://www.ctahr.hawaii.edu/haraa/videos.asp

Hara, A.H. R.Y. Niino-DuPonte, S.K. Cabral, K.L. Aoki, and J.A. Zarders. 2015. Shipping pest-free plants and plant products to California: Exporting pest-free plant products from Hawai‘i. Part 2A: Most Intercepted Pests on Shipments (Introduction and Scale Insects). CTAHR, UH Mānoa, Komohana Research and Extension Center, Hilo, HI. http://www.ctahr.hawaii.edu/haraa/videos.asp

Hara, A.H. R.Y. Niino-DuPonte, S.K. Cabral, K.L. Aoki, and J.A. Zarders. 2015. Shipping pest-free plants and plant products to California: Exporting pest-free plant products from Hawai‘i. Part 2B: Most Intercepted Pests on Shipments (Mealybugs to Thrips). CTAHR, UH Mānoa, Komohana Research and Extension Center, Hilo, HI. http://www.ctahr.hawaii.edu/haraa/videos.asp

Hara, A.H. R.Y. Niino-DuPonte, S.K. Cabral, K.L. Aoki, and J.A. Zarders. 2015. Exporting Pest-free Plant Products from Hawai`i: Best management practices for Little Fire Ants. CTAHR, UH Mānoa, Komohana Research and Extension Center, Hilo, HI. http://www.ctahr.hawaii.edu/haraa/videos.asp

Hara, A.H. R.Y. Niino-DuPonte, S.K. Cabral, K.L. Aoki, and J.A. Zarders. 2015. Exporting Pest-free Plant Products from Hawai`i: Best management practices for Coqui Frogs. CTAHR, UH Mānoa, Komohana Research and Extension Center, Hilo, HI. http://www.ctahr.hawaii.edu/haraa/videos.asp

Hara, A.H. R.Y. Niino-DuPonte, S.K. Cabral, K.L. Aoki, and J.A. Zarders. 2015. Exporting Pest-free Plant Products from Hawai`i: Best management practices for Slugs and Snails. CTAHR, UH Mānoa, Komohana Research and Extension Center, Hilo, HI. http://www.ctahr.hawaii.edu/haraa/videos.asp

Russell H. Messing:

Area addressed Production Agriculture

Activities: Conducted early detection monitoring for coffee berry borer in coffee production areas of Kauai island. Educated growers and field crews about recognition and control of CBB**.**

Outputs: **Products delivered. Examples are reports, publications, and presentations**

Donato R., E. Donati, A. Canale, R. H. Messing, G. Benelli & C. Stefanini. 2016. Lateralized courtship in a parasitic wasp. Laterality: Asymmetries of Body, Brain and Cognition, 21(3): 243-254.

Giunti, G., G. G. Benelli, R. H. Messing, A. Canale. 2016. Early adult learning affects host preferences in the tephritid parasitoid *Psyttalia concolor* (Hymenoptera: Braconidae). Journal of Pest Science, 1-9.

Giunti, G., G. G. Benelli, A. Canale, R. H. Messing, E. Donati, C. Stefanini & J. P. Michaud. 2015. Parasitoid learning: current knowledge and implications for biological control. Biological Control, 90: 208–219.

Subramaniam J, Murugan K, Panneerselvam C, Kovendan K, Madhiyazhagan P, Mahesh Kumar P, Dinesh D, Chandramohan B, Suresh U, Nicoletti M, Higuchi A, Hwang JS, Kumar S, Alarfaj AA, Munusamy MA, Messing RH, Benelli G. 2015. Eco-friendly control of malaria and arbovirus vectors using the mosquitofish *Gambusia affinis* and ultra-low dosages of *Mimusops elengi*-synthesized silver nanoparticles: towards an integrative approach? Environmental Science and Pollution Research, doi: 10.1007/s11356-015-5253-5

Benelli, G. G., D. Romano, R. H. Messing, A. Canale. 2015. Population-level lateralized aggressive and courtship displays make better fighters, not lovers: evidence from a fly. Behavioural Processes 115: 163-168.

Chapman, E. G., R. H. Messing, J. D. Harwood. 2015. Determining the origin of the coffee berry borer invasion of Hawaii. Annals of the Entomological Society of America 108 (4): 585-592.

Canale A., G. Gennari, R. H. Messing & G. Benelli. 2015. Impact of a long-lasting adult liquid diet on female reproductive performance in the Mediterranean fruit fly, *Ceratitis capitata* (Diptera: Tephritidae). Journal of Asia-Pacific Entomology 18: 263–265.

Benelli, G. G., N. Desneux, Conte, G., Donati E, R. H. Messing C Canale, A. 2015. Contest experience enhances aggressive behaviour in a fly: when losers learn to win. Scientific Reports 5: 9347.

Benelli, G. G., N. Desneux, R. H. Messing & A. Canale. 2015. Sex differences in fighting-induced hyper-aggression in a fly. Animal Behaviour 104: 165-174.

Murugan K, Priyanka V, Dinesh D, Madhiyazhagan P, Panneerselvam C, Subramaniam J, Suresh U, Chandramohan B, Roni M, Nicoletti M, Alarfaj AA, Higuchi A, Munusamy MA, Khater HF, Messing RH, Benelli G. 2015. Enhanced predation by Asian bullfrog tadpoles, *Hoplobatrachus tigerinus*, against the dengue vector *Aedes aegypti* in an aquatic environment treated with mosquitocidal nanoparticles: towards "boosted" biological control? Parasitology Research 114: 3601-3610.

Benelli, G. G., D. Romano, R. H. Messing & A. Canale. 2015. First report of behavioural lateralisation in mosquitoes: right-biased kicking behaviour against males in females of the Asian tiger mosquito, *Aedes albopictus.* Parasitology Research, 114(4): 1613-1617.

Benelli G, Donati E, Romano D, Stefanini C, Messing R. H, Canale A. 2015. Lateralization of aggressive displays in a tephritid fly. *Naturwissenschaften* 102(1-2): 1-9.

Mark G. Wright

Area addressed: Managing invasive insect species in Hawaii with emphasis on biological control

Participated in farmers day presentations addressing macadamia nut IPM; Coffee berry borer IPM; tomato virus vector management. The Macadamia nut and coffee workshops are reported by Kawabata, above.

Tomato virus vector management workshops (demonstrating use of varietal resistance and reflective mulches for vector deterrence), were attended by approximately 25 growers each. All were impressed with the varieties trialed (many with dual resistance to Tomato Spotted Wilt Viurs and Yellow Leaf Curl Virus) and the reflective mulches. At least 80% of attendees indicated that they will implement the demonstrated options.

Publications:

Tateno, A., Kaufman, L., Wright, M.G., Sugano, J., Radovich, T. 2015. Field screening of tomato varieties resistant to Tomot Spotted Wilt Virus and Yellow Leaf Curl virus in Hawaii. Hana'Ai/The Food provider http://www.ctahr.hawaii.edu/sustainag/news/articles/V22-Tateno-tomato.pdf

Peer-reviewed journal papers:
Lu, B., Jin, Q., Wen, H., Bellis, G.A., Wright, M.G., Peng, Z., Wan, J., Guo, D. Biological, physiological and genetic response of *Tetrastichus brontispae* (Ferriere) (Hymenoptera: Eulophidae) following exposure to low temperature. *BioControl* (In press). DOI 10.1007/s10526-016-9757-9.

Manandhar, R. & Wright, M.G. 2016. Effects of interplanting flowering plants on the biological control of corn Earworm (Lepidoptera: Noctuidae) and thrips (Thysanoptera: Thripidae) in Sweet Corn. *Journal of Economic Entomology* 109: 113-119.

Leblanc, L., San Jose, M., Wright, M.G. & Rubinoff, D. 2015. Declines in biodiversity and the emergence of pest species across land use gradients in Southeast Asia. *Landscape Ecology* 31:505-516. (DOI 10.1007/s10980-015-0276-3).

Greco, E.B. & Wright, M.G. 2015. Ecology, biology and management of the black twig borer (Coleoptera: Curculionidae: Scolytinae) with emphasis on coffee in Hawaii. *Journal of Integrated Pest Management* 6(1) 7; DOI: 10.1093/jipm/pmv007.

Manandhar, R., Wright, M.G. 2015. Enhancing biological control of corn earworm, *Helicoverpa zea* and thrips through habitat management and inundative release of *Trichogramma pretiosum* in corn cropping systems. *Biological Control* 89: 84-90.

Tavares, J.M., Villalobos, E.M. & Wright, M.G. 2015. Contribution of insect pollination to *Macadamia integrifolia* production in Hawaii. *Proceedings of the Hawaiian Entomological Society* 47: 35-49.

Grants:

Cho, A.H., Wright, M.G., Kawabata, A.M. Canopy modification for macadamia felted coccid management in macadamia nut orchards in Hawaii. USDA-Western Integrated Pest Management Center. $27,282 (2016-2017).

Wright, M.G., Cho, A. Integrated management of macadamia felted coccid. Hawaii Department of Agriculture. $230,000 (2016-2018)

Wright, M.G., Curtis, R. Survey of pests of coffee. USDA-APHIS. $165,000. (1026-2017).

Wyoming State Report WERA-1017

University of Wyoming - Scott Schell, IPM Coordinator/Arthropod Diagnostician

5 Aug, 2016

Area addressed: Arthropod Diagnostic service provided for every stakeholder group in Wyoming (e.g. Urban and Community, Production Agriculture, Rangeland, Natural Ecosystems, etc.)

Extension Entomology team: Prof. Alex Latchininsky and Scott Schell

Organized function: The University of Wyoming Arthropod Identification service provides the first step of IPM, the identification of the pest, and then recommends the appropriate management steps to the people of the state of Wyoming. The most recent tally of public contacts within the last 10 months:

- Phone calls on pest management (in & out): 178
- Walk-in office visitors with samples: 23
- Emails Sent about arthropod sample diagnosis and management: 357
- Emails Received about arthropod sample diagnosis and management: 735
- *AAE - "Ask An Expert" (https://ask.extension.org/ask) requests: 14
- Physical Samples submitted mailed in for diagnosis: 22

Outputs: Summary of Extension Entomology team member S. P. Schell's IPM education presentations from Oct.1, 1, 2015 to May 31st of 2016:

• Laramie Rivers Conservation District field day presentation for school children at Curt Gowdy State Park, Oct. 7, 2015 (Approximately 40 grade school children and their teachers).

• Manned an information and display table at the Carbon County, Wyoming, Extension Office Open House, Rawlins, WY on Oct. 9, 2015 (engaged with 15 people at the table).

• Presented at the "IPM of Wyoming Specialty Crops" program, Oct. 31, 2015 Wheatland, WY (20 people pre-registered for the program)

• Presented the extension entomology update at the Wyoming Weed & Pest Fall conference, Laramie, WY Nov. 3, 2015 (approximately 30 people).

• Presented a lecture on Institutional and Household IPM at the pesticide applicator certification/license class in Laramie, WY Dec. 15, 2015 (approximately 60 people).

• Presentation on grasshopper bio-pesticide development experiment and attendance at the National Grasshopper Management Board meeting, in Denver, CO Jan. 19-21, 2016 (approximately 30 people).

• Local garden club presentation on IPM in Laramie, WY Jan. 26, 2016 (approximately 30 people).

• Master Gardener presentation in Cheyenne, WY Feb. 10, 2016 (32 adults and 2 children)

• Attended "Interagency" meeting in Cheyenne on Feb. 17, 2016 (10 people - WDA, WY G&F, APHIS, BLM, FS, USFWS represented).

• Gave two Master Gardener presentations on Feb. 25th. One in Afton (actually it was in Thayne, WY) for 8 people and one that evening in Evanston, WY for 12 people.

• Gave two presentations, one on grain bin IPM and the other on grasshopper IPM, at the WESTI Agriculture producer event in Worland, WY via Zoom technology on Feb. 19 and 20, 2016. I did it remotely for Dr. Youngquist, the organizer, who told me 8 and 12 people attended the webinars, respectively.

• Master Gardener presentation in Torrington, WY in the evening on Mar. 17, 2016 (5 people)

• Master Gardener presentation in Laramie, WY in the evening on Mar. 19, 2016 (13 people)

• Developed the entomology test and proctored it and the grain grading test at the State FFA Agronomy contest. Apr. 4, 2016 (Over a 100 Wyoming high school Students attended the contest at the Albany Fairgrounds building).

• Presented on agronomic pest IPM at the Weed & Pest Spring Workshop, Worland, WY on Apr. 6, 2016 (Approximately 60 people in the audience).

• Manned an Arthropod IPM information and display table at the Albany Co., Extension Office Open House, Apr. 7, 2016 at the Laramie fairgrounds (engaged with approximately 12 people).

• Master Gardener presentation in Gillette, WY on the morning of Apr. 9, 2016 (8 people).

• Entomology presentation for school children at Lusk, WY Elementary School, Apr. 20, 2016 (Approximately 24 5th grade students and 3 adults).

• Manned an arthropod IPM information and display table at the WY Territorial Park, Laramie, on Apr. 23, 2016 (Over 600 people attended the event, I had an estimate 300 people stop by my exhibits, mainly children to pet the lubber grasshoppers).

• Master Gardener presentation in Lander, WY in the morning of May 6, 2016 (6 people)

Short-term Outcomes:

In the reporting period there were 84 Master Gardener trainees that where taught basic insect identification and had to identify 5 unknown insects to their correct Order using the dichotomous key from the Peterson's Field Guide to Insects. They were also then familiarized with how to use the entomology reference manuals each Univ. of Wyoming Extension office has in its library. Data compiled by the Extension Master Gardener Committee in 2015 showed that an average Master Gardener volunteers returned 60 hours to the program and the national estimated value of volunteer time is $23.07 per hour. If all of these student complete the training program this would potentially provide over $115,000 worth of volunteer service to University of Wyoming Extension.

Longer term Impacts:

- New Master Gardeners learn the first step in IPM is identification of the pest causing the problem and are then able to make appropriate management suggestions.
- Raise Master Gardener student awareness of the abundant reference material developed to assist with IPM in horticulture and how to use it.
- Reduce pesticide use through education on what creatures are important pests and that the vast majority of arthropods species are not pests.

Area addressed: School IPM

School IPM Specialist: John Connett

Organized Function: Wyoming School IPM Adoption Outreach

The Wyoming School IPM outreach program promotes preventative practices and a systematic approach that reduces pesticide use while making pest control more effective and safer for occupants. School IPM training is now being included in Wyoming pesticide applicator training to improve knowledge of pest control operators to explore alternatives to pesticides. A major goal of the program, that has been achieved, is the improved communication and collaboration among Wyoming school districts, University of Wyoming Extension personnel and other partner organizations in Wyoming.

Training Activities and Presentations:

• Conducted School Integrated Pest Management (IPM) and pest prevention training workshops and seminars for school facilities operators, county and state employees, groundskeepers, and pesticide applicators

• Cooperated with national and regional IPM coordinators, Colorado IPM Coalition, WDA, and EPA to establish IPM in and around facilities.

• Wrote technical bulletins for IPM around schools pertaining to mice, bedbugs, turf management, filth flies that include only safe options that are focused on prevention

• Conducted integrated pest management inspections and evaluations of school facilities

• Contributed to the biannual Wind River Tribal Health Fair

• Assisted with IPM program grant writing and budgeting

• Redesigned and maintained robust website for Wyoming School IPM material

• Taught the use of PICOL (Pesticide Information Center Online) for schools

• Continued to develop chapters for a Wyoming School IPM Handbook

• Edited new training material for the core manual for Wyoming State Pesticide Applicators manual

• Provided phone and email IPM support for various school district, pest control contractor, and Wyoming health department personnel

• Vetted training materials for the "IPestManager" School IPM resource database

• Cooperating on a grant with Dawn Gouge University of Arizona and Janet Hurley of Texas A&M and will assist in developing national SIPM rodent control training if the grant is funded

• Participating in the School IPM 2020 Steering Committee and the Western School IPM Working Group

• Wyoming designate for the WERA1017 (Western Region Multi-state IPM team) meeting in Boise summer 2016

• Strategizing with Western School IPM Working Group to implement and assist with the statewide distance delivery in Wyoming of "Stop School Pests" - A National IPM Standard Training and Certificate Program for learning lessons for all school community stakeholder groups including: school administrators, facility managers, pest management professionals/school IPM coordinators, landscape and grounds staff, custodians, maintenance staff, nurses, food service staff and teachers

• Working with local school district personnel on ways to improve their IPM practices

• The ongoing mouse IPM program that we established in UW, College of Agriculture, Plant Science department has been successful and very well received for over one year

• Working with the Wyoming Athletics Landscaping and Facilities to develop an IPM program for their fields and areas adjacent to facilities including, safe, legal, cost saving, and sustainable solutions for weed and pest management

Outputs:

Most Wyoming school facility managers don't have offices with desk top computers. However most do have smart phones so making the information on the Wyoming school IPM web site completely compatible with those devices will be a priority for future improvement and development. See the Wyoming School IPM web site at: http://www.uwyo.edu/wyschool_ipm/

Appropriate forms for school districts to use for establishing verifiable IPM programs have been developed and are served electronically at: http://www.uwyo.edu/wyschool_ipm/forms.html

Short-term Outcomes:

The people performing pest control for school districts in Wyoming who attended the presentations now understand that IPM practices are not onerous government imposed regulations that will make their life difficult. Instead, they now know that IPM can be a way to do their jobs better, with lower costs, and greater environmental safety.

Here are a sample of comments extracted from evaluations given after school IPM presentations:

“It’s really nice to have IPM training that applies to pest control around school facilities” - Gary Barker, Facilities and Maintenance Supervisor for Uinta County School District 1

“Make these school IPM classes longer to discuss details more in depth” Blake Davis, Mechanical Systems Supervisor

“The school IPM training really helps us do a better a better job while protecting students” Austen Eusek, Grounds Supervisor for a school district.

“IPM programs are an effective way to minimize pesticide exposure while improving health and safety in schools. The implementation of IPM as a management strategy is the safest and most effective approach because it minimizes pesticide use in schools" Dixie Thomas, Wyoming Department of Agriculture inspector

Longer-term Impacts:

- Increase adoption of IPM practices in Wyoming school districts.
- Reduce pesticide usage in Wyoming school facilities
- Make resources on the implementation of IPM easily available to Wyoming school district personnel

Area Addressed: Rangeland and Community IPM

Extension Entomology team: Alex Latchininsky and Scott Schell

Activities: Organized two IPM workshops

Description: Entomology Short Course

Organized and also presented at the 12th Annual Entomology Short Course on March 15-17, 2016 in Laramie for 22 attendees. The emphasis of the training was IPM for Wyoming Counties' Weed & Pest district personnel. Although enrollment is open to the public the majority of the students are always from Wyoming's 23 county Weed & Pest districts in Wyoming. These counties have an umbrella organization, the Wyoming Weed and Pest Council (to learn more about http://www.wyoweed.org/. Each county's district is funded with a mill levy and have a supervisory board made up of citizens from that county. The Entomology Short Course attendees pay a fee to cover the costs of the course which is 16 hours long and is conducted over 3 days in March each year.

In an anonymous course evaluation given at the end of the training the students were asked if the course was a valuable use of their time and if they would recommend it to their colleagues. Out of 16 responses, the student's average score for the course was 9.7 and 9.9 out of possible 10, respectively, for those two questions.

Short-term Outcomes:

Basic insect identification is the heart of the training course and the students have to be able to identify to Order 10 unknown insect specimens using a dichotomous key by the end of the course. They are also provided with basic reference books as part of the course packet and shown where to find and how to use additional IPM based pest management tools.

Longer-term Impacts:

The county Weed & Pest districts in Wyoming are the major applicators of pesticides in the state. In many counties they are also the biggest retailers of pesticides to the local populace. By educating the people who work for the districts we help influence how pesticides are used in the entire state.

Description: Mosquito Larval Control and West Nile virus prevention workshop

Organized, promoted, and presented the 5th annual Mosquito Larval Control and West Nile virus prevention workshop in conjunction with City of Laramie Mosquito Control and the Wyoming Department of Agricultures' Emergency Insect Management Grant (EIMG) program for mosquito abatement personnel on May 24-25, 2016 in Laramie for 25 attendees. This workshop is for employees of small Wyoming mosquito abatement districts, many of whom have no background in pest control or any form of biological science when hired to do their job. A small grant of $5,700 from the Wyoming Dept. of Agriculture funds the costs of the 12 contact hour course, including the hotel stays for the student travelling more than one hour one way to attend the course.

The students are given hands-on training on:

- Basic mosquito biology and ecology
- Identification of mosquito larval habitat
- Sampling for larval mosquitos
- Selection and placement of mosquito surveillance traps
- Selection of control products
- Calibration of application equipment

The workshop students also learn to identify mosquitoes from other insects and identification of common genera of larval and adult mosquitoes. In addition, the student learn the specific diagnostic characters of Wyoming's primary vector of WNV, *Culex tarsalis*, in the laboratory and how to best preserve mosquito specimens for submission for virus detection with RAMP® testing equipment. The students have to successfully complete a 12 question mosquito identification exercise with actual specimens to be awarded their course certificates.

In the course evaluation given at the end of the training the students are asked if the course was a valuable use of their time and if they would recommend it to their colleagues. Out of 23 responses, the student's average score for the course was 9.3 and 9.1 out of 10, respectively, for those two questions.

Short-term Outcomes:

Provide basic training for mosquito abatement personnel to protect the health of Wyoming's citizenry from West Nile virus using IPM.

Longer-term Impacts:

The desired long term impact is to have trained people in mosquito IPM that are able to respond to established or newly introduced arthropod borne disease threats with the appropriate methods that safeguard human health.

Area Addressed: Rangeland and Community IPM

University of Wyoming Rangeland Weed IPM Team: Brian Mealor, Cara Noseworthy, Julia Workman, and Beth Fowers

Outputs: Presentations

Each of these presentations discussed at least one facet managing weeds with an integrated approach.

Audiences included: federal, local, and state land managers, private landowners, wildlife management personnel, extension educators, and other natural resources professionals and more than 1500 people were present for these presentations.

Mealor, B.A. 2015. Strategic cheatgrass management. University of Nebraska Cheatgrass Management Workshop. Scottsbluff, NE.

Noseworthy, C.E. and B.A. Mealor. 2015. Beyond presence/absence: Prioritizing cheatgrass management in Wyoming. Governor's Subcabinet on Natural Resources. Cheyenne, WY.

Mealor, B.A. 2015. Managing invasive weeds in sage grouse habitat. Sage Grouse Habitat Restoration Workshop. Casper, WY.

Noseworthy, C.E. and B.A. Mealor. 2015. Beyond presence/absence: Prioritizing cheatgrass management in Wyoming. Sage Grouse Habitat Restoration Workshop. Casper, WY.

Fowers, B. and B.A. Mealor. 2015. Cheatgrass research and management in Wyoming. Cheatgrass informational workshop. Pinedale, WY.

Fowers, B. and B.A. Mealor. 2015. Managing weeds in reclamation. Reclamation Best Management Practices Workshop. Pinedale, WY.

Fowers, B. and B.A. Mealor. 2015. New weed occurrences in Wyoming: Weeds on the move. Wyoming Weed Management Association. Casper, WY.

Workman, J.W. and B.A. Mealor. 2015. Targeted grazing and herbicide for Dalmatian toadflax and geyer larkspur management. Wyoming Weed Management Association. Casper, WY.

Noseworthy, C.E. and B.A. Mealor. 2015. Cheatgrass research in Wyoming: Prioritization and targeted grazing. Wyoming Weed Management Association. Casper, WY.

Mealor, B.A. 2015. Managing poisonous plants. Wyoming Weed Management Association. Casper, WY.

Wyoming Restoration Challenge – Initiated in spring 2015, this is a participatory educational project. Thirteen teams from various organization involved with weed management registered for this competition where success is evaluated by how well a teams' integrated weed management and restoration approach improves ecosystem condition in a weed-degraded site. This time-intensive competition will continue until 2017. Hard copy and digital outreach materials, including social media, are currently being developed. To learn more visit:

http://weedcontrolfreaks.com/2015/04/wyoming-restoration-challenge-part-1/

or

https://www.facebook.com/WYrestorationchallenge/

Select University of Wyoming IPM Publications:

Peer-reviewed:

Schell, S. P. 2015. Chapter 3. Large-scale grasshopper infestations on North American rangeland and crops. in "Biological and Environmental Hazards, Risks, and Disasters" Editor R. Sivanpillai. Elsevier. ISBN9780123948472

Extension:

Connett, J.F., S.P. Schell, and A.V. Latchininsky. 2015. Wyoming Integrated Pest Management (IPM) Standard Operating Procedure (SOP) for Filth Flies in Schools and Other Facilities. B-1276, University of Wyoming.

Jones, A., M. Pellissier, R. Jabbour. 2015. Insects in Wyoming Alfalfa. B-1275,University of Wyoming Extension.

Scasta, J. D. and S.P. Schell. 2016. It's been a lousy year for range cattle – got lice? For the June 2016 issue of the Wyoming Livestock Roundup.

Schell, S. P. 2016. European paper wasp, a world traveler finally arrives in Wyoming. in "Backyards and Barnyards' Winter 2016 issue. Editors: Steve Miller and Jennifer Thompson.

Schell, S. P. 2016. Garden pest control may not require heavy artillery; there are alternatives before reaching for a sprayer. for "Backyards & Barnyards". Spring 2016 issue Editors: Steve Miller and Jennifer Thompson.

Smith, M., A. Garrelts. B. Sebade, W. Kelley, S. Schell, M. Smith, J. Derek Scasta, R. Mealor, B. Stam. Editors: Steven Miller & Mae Smith. 2015. Rangeland Plants: Wyoming Tough. B-1265, University of Wyoming Extension.

WERA1017/PD Workshop

Attending: Amanda Crump, Steve Elliott, Matt Baur, Jim Farrar, Tanyalee Martin, Karey Windbiel-Rojas, Cheryl Wilen, Steve Fennimore, Doug Walsh, Paul Jepson, Katie Murray, Len Coop, Peter Ellsworth, Al Fournier, Dawn Gouge, Mary Burrows, Laurie Kerzicnik, Steve Seefeldt, Ed Bechinski, Rhonda Hirnyck, Jacqueline Lucero, Tom Holtzer, Bob Schlub, Marion Murray, Diane Alston, Frank Peairs, Ashley Bennett, Joy Paterson

1. Western IPM Center discussion
    - Center adds value by facilitating cooperation
    - Logic models provided by EIP and ARDP recipients used to identify syngergies among states and projects
    - Logic models did not highlight regional collaboration
    - When asked ahead of time, many states wanted to talk about community IPM
    - States also want to talk about:
        - IPM in natural areas
        - barriers to adoption
        - coordination with federal partners (NRCS was mentioned in particular)
        - pesticides and risks to human & environmental health
        - fumigant alternatives
        - the pipeline of new IPM tools
        - Opportunities to advance IPM because the agricultural chemical industry is facing challenges
        - Updating the NIMSS and listserve, and communicating more within the WERA committee
        - Avenues for publishing images

2. REPORTS
    - California (EIP-Jim Farrar) addressed:
        - urban checklists (www2.ipm.ucanr.edu/landscapechecklist)
        - Decision support tool for chlorpyrifos (www2.ipm.ucanr.edu/decisionsupport/)
        - Alternatives to fumigants
        - Extensions role in assuring safe and accurate pesticide applications
        - The issue of structural pest control outreach

    - Arizona (ARDP – Dawn Gouge)
        - National assessment of bed bug impacts and demonstration of IPM in high risk elder/disabled housing facility
        - Five sites, 612 units in Maricopa, AZ
        - Need effective pest management tools rather than attempts to change behavior
        - Cost is related to quality of pest management

- Montana (EIP – Mary Burrows)
    - Diagnostic lab servicing seven states, processing 2800 samples last year, increased pulse crop production could lead to increased virus sample submissions
    - Strobilurin resistance
    - More proactive outreach including the Montana pest web (pestweb.montana.edu), social media, ag and urban pest alerts (800 subscribers for ag, 80 for urban), booth at farmers markets, noxious weed training for real estate agents, wheat workshop (70 participants)
    - wheat streak mosaic virus outbreak (see June Center newsletter at westernipm.org.
    - MT governors invasive species council (see June Center newsletter)

- Colorado (EIP – Frank Peairs)
    - Recent outputs include: Common pests of schools and structures in Colorado (2015), wood boring insects of ash trees in Colorado, homeowner insecticide updates, and a biologicals pesticide list.
    - School IPM has reached 80% adoption in partnership with EPA region 8
    - Vegetable University set to deliver IPM tools to low-income food deserts and promote backyard farming
    - Diagnostic laboratory processing 2000-3000 samples per year

- Utah (EIP - Marion Murray)
    - School IPM
        a. Pest ID handbook developed in conjunction with Colorado
    - Vegetable production
        a. Targeting small farms, community gardens, and nursery
        b. Advisories sent to 8,000 recipients (about 25% commercial) on fruits, vegetables, ornamentals and turf
    - Fruit production
        a. Invasive fruit pest guide
        b. intermountainfruit.org in collaboration with CO and ID
        c. fruit pest finder mobile app
        d. wild hosts of SWD and leafrollers
        e. emerging pests include:
            i. pear sawfly (Hoplocampa brevis)
            ii. sequoia pith moth (Synanthodon sequoia)
    - Other
        a. Online survey to estimate impacts shows increased level of IPM use and a 25% cost savings with increased IPM adoption
        b. Utah TRAPs (climate.usurf.usu.edu/traps/) in partnership with Utah Climate Center

c. Ground squirrel control on small farms (WSARE funded)
d. Interpretive IPM signs in public gardens

- New Mexico (State Report – Ashley Bennett)
  - New urban and small farms advisor
  - Background in urban landscape and pollinators
  - Interested in working on
    a. Ecological services preservation with master gardeners and ag professionals
    b. Urban center open spaces issues with urban foresters
    c. New technologies

- Guam (EIP – Bob Schlub)
  - New pathologist hired
  - Involvement of other pacific island territories
  - Identify unmet needs
  - Question for USDA arose from this discussion about multi territory EIP grant applications
  - Question about pacific island territories involvement in regional technical committees for Mike Harrington

- Nevada (EIP – Joy Paterson)
  - Four programs funded under EIP:
    - urban
    - agriculture
    - horticulture
    - noxious weeds
  - Urban and horticulture programs target small scale farmers with variable backgrounds using fact sheets, urban areas are not limited to Las Vegas and Reno
  - For noxious weeds, the program is using Eddmaps to track with monitoring help from federal partners and crowd sourcing.
  - Web site (www.unce.unr.edu/programs/sites/ipm) and social media used for outreach
  - New agricultural crops for Nevada include wine grapes, teff and hops because of the need to diversity from onion and alfalfa and supply local markets

- Washington (EIP – Doug Walsh)
  - EIP funding covers
    - urban
    - agriculture
  - Urban program is partnering with salmon safe to reduce urban pesticide runoff through IPM

- Workshops for structural pest control and the use of the ‘sick house’
- Markers for resistance in beg bugs (Feng Zhu).
- Agricultural outputs include the Hop and wine grape PMSPs and the Field Guide for Integrated Pest Management in Hops

- Wyoming (EIP – Dawn Gouge presenting for John Connett)
  - School IPM well received at most districts due to personal contact with facilities directors
  - Haanshen Barley mealy bug; out break in 2014 and not found again
  - Alfalfa weevil population increasing since 2014 and treatment increasing annually
  - Cattle chewing lice outbreak 2016 resulting in cattle deaths. Information and outreach needed for proper identification and effective control strategies.
  - Cereal leaf beetle high population in 2015.
  - Wheat fields in eastern Wyoming are bring "baled for feed" before flowering due to drought
  - Wheat stem saw fly has been increasing lodging in the last two years. Growers are breaking no-till cycles with deep tillage to bury infested stems.
  - Spotted wing drosophila was a problem in 2014 but has not been spotted since

3. URBAN AND COMMUNITY IPM DISCUSSION

- Opportunities for collaboration (and states declaring interest in the subject area)
  1. Community Ag and small farms (CA, AZ, NM, MT, OR)
  2. Risk mitigation (OR, CA, AZ, ID
  3. Human health and vector ecology (AZ)
  4. School IPM (AZ, WA)
  5. Vertebrate IPM (WERA95 was a WAAESD committee on vertebrate pests of ag, forestry, and public lands, ended 2009)
  6. Structural IPM (CA, AZ, WA)
  7. Workgroup to identify synergies between PSEP and IPM (AZ, ID, OR, CA, AK, MT, WY, NV)
  8. Technology advances as alternatives to chemical solutions
  9. Alternatives to fumigants (CA, OR, ID)
  10. IPM network work group through the Center (AZ)
  11. Collaboration work group through the Center
  12. Suggestions to the weather work group on priority projects (OR)
  13. Tribal IPM (MT, AK, AZ)
  14. App development – possible center of excellence (AZ)
  15. Pest resistance
  16. In-service training (ID)
- Survey states about collaboration, separate questions by teaching, research and

extension (Al Fournier will draft, to be reviewed by Diane Alston and Paul Jepson).

4. REPORTS CONTINUED

- Idaho (EIP – Ed Bechinski)
  - In service training provided to 23 county educators, state specialists and master gardener support staff from Idaho, Montana, and Utah. Participants receive items to improve diagnostic capabilities.
  - Decision tool (Aphid Tracker available at www.cals.uidaho.edu/aphidtracker) for dry peas
  - Economic analysis of the value of the decision tool to producers

- Oregon (ARDP – Len Coop)
  - Medium- and extended-range weather and climate forecasts scaled and tested for improved IPM decision support in the US
  - Collaborations with AgWeatherNet, USDA APHIS, and CAPS (cooperative agricultural pest survey) coordinators, PPQ-CPHST (Center for Plant Health Science and Technology)
  - New interface for USPEST.org
  - PRISM additions will substantially improve long range forecasts
  - Developing forecast maps of invasive and pest species range expansions or changes based on long term weather forecasts.

- Alaska (EIP – Steve Seefeldt)
  - Goal to identify and visit farms and provide information they need to reduce the rate of pest establishment
  - Develop and maintain a central clearinghouse of pest establishment data and link to NPDN/CNIPM/USFS and others.
  - About 100 farms (out of 700) visited by pest scouts (EIP funded) to provide training to farmers/ranchers
  - Priority pests are those affecting livestock
  - Outputs include:
    - PSEP online courses on buffer zones, calibration, PPE
    - Online training of pest identification and notification

- Oregon (EIP – Paul Jepson)
  - IPPC leverages state money
  - EIP money used for capacity building in the areas of school IPM and Agriculture
  - IPPC invested in pesticide risk management
  - Successes mentioned include

- Adaptive learner-centered education; a toolkit for extension (publication EM9144, June 2016, available at catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/em9144_1.pdf)
- Development of a successful IPM program for the Christmas tree industry to control Douglass Fir needle midges and aphids (both identified as significant challenges in the Christmas tree PMSP, available at ipmdata.ipmcenters.org)
    a. Program relies on midge degree day model
    b. Conservation biological control
    c. Application training and technology advances
    d. See pubs.extension.oregonstate.edu/em9093/douglas-fir-needle-midge

- Arizona (EIP – Peter Ellsworth)
    - EIP money used for capacity building to conduct needs assessment, assess outcomes and impacts and engage stakeholders
    - In vegetables, significant changes in IPM knowledge and adoption of IPM has occurred in the majority of producers
    - APMC (Arizona Pest Management Center), IPM Center, and IR-4 collaboration to develop IPM fit documents (available at wrir4.ucdavis.edu/pst/default.html)
    - Crop pest losses and impact assessment program continues to document IPM successes in melon, lettuce and cotton in Arizona and California.
    - APMC partners with the IPM Center to coordinate comments to EPA dockets
    - APMC continues to maintain the pesticide use database for Arizona, spans 20-25 years.

- Arizona (ARDP – Peter Ellsworth)
    - Prospective resistance management: empowering growers to partition chemistry in space and time
    - Maps generated for resistance management in whiteflies
    - Identify hot spots of use, notify stakeholders and suggest partition of chemistry in time
    - Outreach to stakeholders regarding insecticide resistance management
    - Whitefly population sampling continues to document susceptibility patterns

- California (ARDP – Steve Fennimore)
    - Evaluation of an intelligent intra-row cultivator for weed management in vegetable crops
    - Labor identified as a major constraint in specialty crops in the west
    - Highest cost of labor ($325/acre)>cost of the intelligent cultivator>lowest cost of labor ($250/acre)

- Current technology recognized the cropping pattern and platform can be adapted to multiple crops

5. WRAP-UP AND FINAL COMMENTS

- USPEST.org requests new models to include, currently Utah is developing a degree day model for billbugs
- State IPM/PSEP programs can leverage on-line training modules developed in other states
- Tom retires at the end of September so final report should be handed in well before that date.